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NEW MYRMECOPHILOUS MILLIPEDS FROM BARRO COLORADO ISLAND, CANAL ZONE, AND MEXICO

H. F. Loomis

From February through August, 1956, Mr. and Mrs. Carl W. Rettenmeyer, of the Snow Entomological Museum, University of Kansas, Lawrence, Kansas, collected arthropods associated with colonies of army ants on Barro Colorado Island in the Canal Zone, in connection with a project sponsored by the National Science Foundation. Their work resulted in finding over 250 specimens of millipeds in 21 colonies of four ant species. It has been my privilege to study this most interesting collection made up of seven milliped species, none of which appears to have been previously described, although the writer's own collection contained three of them. In addition, Mr. Rettenmeyer sent specimens of two other undescribed milliped species collected with army ants in southern Mexico in 1945 by T. C. Schneirla.

Descriptions of these novelties follow. Unless otherwise stated, the type locality of each species is Barro Colorado Island, Canal Zone, and the collectors are Mr. and Mrs. Rettenmeyer. Types of all species are deposited in the U.S. National Museum. Paratypes, where available, are in the Snow Entomological Museum, the writer's collection, and the American Museum of Natural History.

Genus *Calymmodesmus* Carl

Calymmodesmus Carl, 1914, Mem. Soc. Neuchat. Sci. Nat., 5:959-961.

The genus *Calymmodesmus* was based on a single Colombian species, *C. andinus,* the only recognized species until the present collection, which contains a number of species that possess, essentially, the generic characters set forth by Carl. Without exception, the first segment in these species has 12 lobes on the anterior margin, instead of 10 as stated for *andinus,* but in one species, *biensifer,* the three outer lobes on each side of the margin are almost completely joined, forming two very broad lobes with their component parts but faintly distinguishable, whereas the six inner lobes are conspicuous. Carl's illustration of the first segment of *andinus* shows a somewhat similar condition as the outer lobe on either side is considerably broader than any of the inner ones and has a slight median emargination indicating that two lobes had been united.

Several characters not included in the generic description but common to all the species should be mentioned. Joints 5 and 6 of the antennae each have a small dense pad of hairs at the distal end on the outer side; lateral carinae of segment 19 are oblique, only moderately produced backward, and generally have the posterior corners broadly rounded; last segment

with six marginal lobes although the median pair may be almost united or apparently completely so, as in *andinus*.

Attention should be called to the fact that several species of Chamberlin's genus *Yucodesmus* (Carnegie Inst. Pub. 491, p. 178-182, 1938) have gonopods and additional generic characters similar in type to those of *C. biensifer*, and study of his types or additional specimens of the species may show the genus to be a synonym of *Calymmodesmus*.

Calymmodesmus formicatus new species

A large number of specimens from four collections, numbers 1814, 1820, 1824 (containing male type) and 1826, all associated with *Nomamyrmex esenbecki crassicornis* (F. Smith). A male and female collected in 1910 from "depressed ant path" in Ancon, Canal Zone, by A. H. Jennings.

Description. Largest of the species; 10 to 10.5 mm. long and 2.5 to 2.8 mm. wide. Body with dorsal arch low, the lateral carinae wide and nearly horizontal. Head with sculpture of vertex of typical form and arrangement but not sharply demarcated. First segment with disk not very abruptly raised, the 10 large tubercles of uniform size, low and indistinct. Ensuing segments with the four primary rows of tubercles subequal in size, low and quite indefinite in limitations. Segment 19 with lateral carinae oblique, definitely wider than long; outer margin, including anterior and posterior corners, rounded, the four lateral lobes faintly indicated by dorsal channels. Last segment broad, the six lobes distinct and well separated from each other, the outer one on each side largest. Gonopods as shown in figures 1 and 2. Males with the coxae of legs 7 and 9 elevated into conic, hispid tubercles, this being the only species showing this modification.

Calymmodesmus falcatus new species

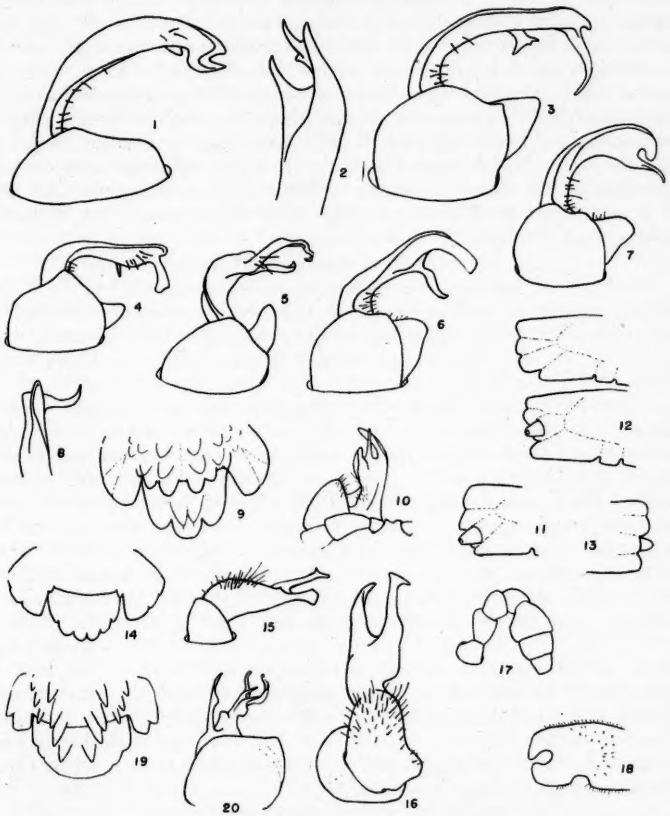
A male in collection 1814 and two males (one the type) in collection 1824, taken in association with *Nomamyrmex esenbecki crassicornis* (F. Smith).

Description. Broadest and flattest of the species, being 9 mm. long and 2.5 mm. wide, the lateral carinae more continuous with the low dorsum than in any other species. Head with sculpturing of vertex typical in arrangement, with tubercles of central area indistinct. Body segments with the four primary rows of tubercles of subequal size, the inner pair scarcely more evident than the outer ones and all tubercles rather small and indefinite. Penultimate segment as in *formicatus*. Last segment short, the outer lobe on each side long-conical and well separated from the next one, which in turn is less strongly separated from the median pair, these being smaller and little separated from each other. Gonopods as shown in figure 3.

Calymmodesmus rettenmeyeri new species

This species was the one most commonly found with ants, two collections, 1814 and 1826 (including male type), being taken with *Nomamyrmex esenbecki crassicornis* (F. Smith) and seven collections, 1871, 1876, 1877, 1905, 1906, 1912 and 1913, with *Labidus praedator sedulus* Menozzi. With the latter ant a single male was collected at Madden Dam, Canal Zone, by Wm. Lundy, Oct. 21, 1956.

Description. A species slightly smaller than the preceding, resembling



Figs. 1 and 2. *Calymmodesmus formicatus* n. sp. 1, gonopod, lateral view; 2, apex of gonopod with more magnification, vertical view. Fig. 3. *Calymmodesmus falcatus* n. sp., gonopod, lateral view. Fig. 4. *Calymmodesmus rettenmeyeri* n. sp., gonopod, lateral view. Fig. 5. *Calymmodesmus gracilis* n. sp., gonopod, lateral view. Fig. 6. *Calymmodesmus biensifer* n. sp., gonopod, lateral view. Figs. 7 and 8. *Calymmodesmus mexicanus* n. sp.; 7, gonopod, lateral view; 8, apex of gonopod, with more magnification, vertical view. Figs. 9 and 10. *Cynedesmus trinus* n. sp. 9, segments 19 and 20, dorsal view; 10, gonopod, posterior view. Figs. 11 to 16. *Rettenmeyeria parvipes* n. sp. 11, lateral carina of segment 16, dorsal view; 12, lateral carinae of eighth and ninth segments, dorsal view; 13, lateral carina of ninth segment, ventral view; 14, segments 19 and 20 in outline; 15, gonopod, lateral view; 16, gonopod with more magnification, ventral view. Figs. 17 to 20. *Prionodesmus fulgens* n. sp. 17, antenna; 18, lateral carina of sixth segment, dorsal view; 19, segments 18 and 19, dorsal view; 20, gonopod, lateral view.

formicatus in shape, convexity of dorsum and protrusion of the lateral carinae. Length 8 mm., width 2 to 2.2 mm. Head with sculpturing of vertex rough but indefinite, the ridge and upper tubercle on each side of same height as, and scarcely separated from, rather indistinct tubercles of central area. Segments with median rows of primary tubercles of same size as outer rows on anterior half of the body but larger and more distinct on last few segments. Segment 19 with lateral carinae oblique, about as long as wide; lateral margin broadly rounded, including anterior and posterior corners and with the four lobes evident as crenations. Last segment short with small lobes scarcely separated from each other, especially median pair. Gonopods as shown in figure 4.

Calymmodesmus gracilis new species

Many specimens from the following collections: 1825 and 1826 (including male type) with *Nomamyrmex esenbecki crassicornis* (F. Smith) and 1876, 1906, 1912, 1928 with *Labidus praedator sedulus* Menozzi, with which species Wm. Lundy also collected a male at Madden Dam, Canal Zone, Oct. 21, 1956.

Description. More slender than the preceding species, with dorsum much more convex and with lateral carinae narrower and more obliquely descending. Length 7.5 to 8 mm., width 1.8 to 1.9 mm. Head with typical sculpturing of vertex rather coarse and distinct, each side with a large upper tubercle and a small vertical ridge below it; median area with four or more small, rounded, scattered tubercles. First segment with median area strongly convex, the two inner tubercles of each row distinctly larger than those laterad of them, the two inner ones of the back row largest of all. Ensuing segments with two inner rows of primary tubercles twice as large as outer rows and separated from each other by about the width of one of the rows; secondary tubercles small, indistinct and scattered. Segment 18 with posterior corners of carinae squarely angular. Segment 19 with lateral carinae rather oblique, longer than broad, the outer margin nearly straight and the four lobes distinct and quite sharply indicated; posterior corners definitely angular. Last segment large with the six lobes large and conical and almost uniformly separated from each other. Gonopods as shown in figure 5.

Calymmodesmus biensifer new species

A male (type) and posterior end of body of another specimen collected with *Eciton burchelli* (Westwood) at Loma Bonita, 20 km. south of Tuxtepic, Oaxaca, Mexico, April 30, 1945, by T. C. Schneirla.

Description. Size and shape of *gracilis* with dorsum similarly strongly arched. Length 7.5 mm., width 1.7 mm. Head with a slender vertical ridge and a small round tubercle above it on each side of vertex, the median area with a larger and more distinct vertical oval tubercle on either side. First segment with the three outer marginal lobes on either side almost completely joined together and appearing as two broad lobes with the six median lobes well marked between them; disk strongly convex with the ten primary tubercles large and sharply defined, the two central ones in each row slightly larger than the others. Ensuing segments with the four primary rows of tubercles large and well defined, the two inner rows scarcely

larger than the outer ones on anterior segments but increasing in size on posterior end of body, the two inner rows a little more widely separated than those of *gracilis*. Segment 18 with posterior corners broadly rounded. Segment 19 with lateral carinae oblique, longer than broad and sub-spatulate in outline, being somewhat constricted near body, the outer margin evenly rounded without a hint of anterior or posterior corners and with the lobes obliterated. Last segment of type specimen somewhat malformed, the first lobe on each side small, the next lobe largest on one side but the corresponding lobe opposite as small as the first, the two median lobes almost as large as the larger second lobe and separated from each other slightly. Gonopods as shown in figure 6, the two terminal branches being thin plates but at a right angle to each other.

Calymmodesmus mexicanus new species

Male (type) and posterior end of body of another specimen collected with *Eciton burchelli* (Westwood) at Loma Bonita, 20 km. south of Tuxtepic, Oaxaca, Mexico, April 30, 1945, by T. C. Schneirla.

Description. Size and shape of two preceding species. Head with sculpture of vertex coarser but less sharply defined than in *biensifer*. First segment with crenations of margin subequal in size and prominence. Ensuing segments with inner rows of primary tubercles larger than outer rows on all segments, not almost subequal on anterior segments as in *biensifer*. Segment 18 with posterior corners subangular. Segment 19 with lateral carinae longer than broad and with anterior and posterior margins parallel; outer margin but little rounded and with lobes faint; anterior and especially posterior corners subangular. Last segment quite broad with rather small lobes of subequal size, uniformly separated from each other except the median pair which are slightly less separated. Gonopods as shown in figures 7 and 8.

Genus *Cynedesmus* Cook 1896

Although this genus was founded on a species from Grand Canary Island, several additional species are known from the West Indies and Central America.

Cynedesmus trinus new species

Two males (one the type) collected at Monte Lirio, Canal Zone, June 8, 1923, by O. F. Cook. A male, collection 1862, in association with *Neivamyrmex mexicanum panamense* Borgmeier, from Barro Colorado Island.

Description. Length 4.5 to 5 mm., width .7 to .8 mm. Head with a quadrate area strongly raised above the surface on all sides and beginning just above antennal sockets but not reaching crest of vertex, the raised area with a pronounced median channel with six to eight or more small subconfluent granules scattered on either side; crest of vertex and front of head smooth; antennae short and stout, joint 5 less than twice as long as joint 6. First segment with front margin horizontal and with 12 lobes, outer one on each side half as wide as next one to it; median area rising sharply from margin, very convex, with an anterior row of six large round tubercles and a posterior row of four larger ones. Ensuing nonporiferous segments, including segment 19, with lateral carinae trilobed, the eight

poriferous segments bilobed with the pore tubercle replacing the third lobe at posterior corner; carinae low on sides of body, nearly horizontal and without surface tubercles; dorsum with four longitudinal rows of strong round tubercles and with smaller secondary tubercles between rows. Last segment rather large, with three subequal margining lobes; dorsal surface with two low elongate-conical tubercles having a tiny seta at apex of each (fig. 9). Gonopods as shown in figure 10. Male legs without special modifications.

Rettenmeyeria new genus

Type species: *R. parvipes* new species.

Description. Body small, about four times as long as broad; strongly convex; sculpturing more distinct than in *Calymmodesmus*. Head with a slender ridge on each side of vertex beginning just above antennal socket; surface between ridges with a few small tubercles; antennae short, strongly geniculate, with joint 5 long and thick and with a small pad of fine hairs distally on the outer side; joint 6 with a similar pad. First segment with ten marginal lobes; disk with ten large rounded tubercles in two transverse rows. Ensuing segments with four longitudinal rows of large rounded tubercles, three in each row on each segment; in addition there are a few small scattered secondary tubercles not extending onto the lateral carinae which have the surface finely scabrous; lateral carinae broad, extending outward and somewhat downward, the outer margin on nonporiferous segments with three lobes; pores opening from conical tubercles projecting beyond margins of segments 5, 7, 9, 10, 12, 13, 15 and 16; segment 5 with three lobes but pore cone completely hiding middle one from above; the ensuing poriferous segments with four lateral lobes but with pore cones hiding the third lobe. Last segment with six marginal lobes. Gonopods with basal joint rather small, not galeate and incapable of containing the outer joint, which is quite straight with basal half strongly hispid, the outer portion bifurcate.

Rettenmeyeria parvipes new species

Sixteen specimens from collections 1785, 1786, 1814, and 1829 (including male type), taken in association with *Nomamyrmex esenbecki crassicornis* (F. Smith).

Description. Body small and broad; dorsum quite strongly arched with rather broad, somewhat descending carinae; males narrower than females; length 6.5 to 7 mm., width 1.5 to 1.7 mm. Head with lateral ridge on each side of vertex narrow and uneven at apex; surface between the ridges with six to eight small, scattered, round tubercles. First segment with the ten lobes of front margin ending in indistinct crenations, the surface channels demarcating the lobes more evident on the ventral surface than above; the ten major tubercles of median area subequal in size and larger than tubercles of primary rows on ensuing segments. On these segments the four primary rows of tubercles are equal in size except on last few segments where the two inner rows are larger; secondary tubercles not numerous or in definite arrangement and not extending onto lateral carinae, those between the inner primary rows very small and indistinct. Pore process on segment 16 almost at posterior corner (fig. 11), the fourth lobe of margin

much smaller and projecting less than on other poriferous segments (figs. 12, 13). Segment 19 with dorsal sculpture reduced and indistinct. Last segment broad, rounded behind, with six subequal margining lobes separated from each other by tiny nicks (fig. 14). Gonopods as shown in figures 15 and 16.

Prionodesmus new genus

Type species: *P. fulgens* new species.

Diagnosis. Related to *Botrydesmus* of the Stylodesmidae but having only 19 segments, which are without pores.

Description. Body small and slender, about six times as long as broad and with only 19 segments. Head hidden beneath first segment, with antennae close together, short, crassate; joint 5 widest but little longer than joints 2 or 6. First segment with anterior margin nearly horizontal, slightly descending, and composed of ten lobes separated from each other by deep open sinuses; disk with laterally compressed tubercles acute at apex. Ensuing segments with four high, thin, serrate ridges, each composed of three strongly laterally compressed tubercles on each segment; dorsal surface elsewhere slightly scabrous but shining; lateral carinae descending at about a 45° angle, the outer margin on second segment with three lobes, the ensuing segments, including the penultimate, with two lobes; lobes separated by a deep, strongly lageniform sinus, occasionally filled with organic matter; pores lacking. Last segment conspicuous from above, very broad and with two conical tubercles on surface. Gonopods with large galeate basal joint and a rather short complicated terminal one. Third legs of male thickened.

Prionodesmus fulgens new species

Two 18-segmented females in collection 1187, associated with *Eciton burchelli foreli* Mayr. Four males (one the type) and six females from Barro Colorado Island, March 8 to 15, 1958, and an 18-segmented male from Cerro Campana, Panama, March 16, 1958, collected by H. F. and E. M. Loomis.

Description. Light yellowish, lacking any incrustation of dirt. Length 4 mm., width .7 mm. Head with four small round tubercles across crest of vertex; surface below these and above antennae elevated on either side of a pronounced median channel; front smooth and shining; antennae (fig. 17) separated by about the width of a socket. First segment with outer lobe of front margin narrowest, the second widest, the two lobes usually deeply separated but united in one specimen; disk of segment with a deep median channel, with a smooth, elevated, quadrate area on either side, behind which is a small elongate tubercle followed by a much larger elongate tubercle near back margin; laterad of these tubercles is a triangular group of three larger tubercles. Ensuing segments with lateral carinae bilobed (fig. 18) except on second segment which has three lobes; anterior and posterior margins of carinae with a sparse fringe of fine setae and a few small setae on dorsal surface; posterior margin with a wide and deep excision at middle. Last segment with two small lobes on either side of margin and a very broadly rounded median lobe (fig. 19). Gonopods as shown in figure 20.

SOUND PRODUCTION AMONG NOCTURNAL BEES

E. G. LINSLEY AND J. W. MACSWAIN
University of California, Berkeley

Several authors have mentioned the sound produced by nocturnal bees. Thus, Bingham (1897) states that on fine moonlight nights, the Indian *Xylocopa (Nyctomellita) tranquebarica* (Fabricius) can be heard buzzing all night long. Williams (1927) records the introduced Hawaiian *Xylocopa* buzzing loudly among blossoms before sunrise, and E. S. Ross and H. B. Leech heard the New World *Xylocopa rufina* Maidl visiting flowers in the dim light of dusk in the forest undergrowth on the south slope of Mt. Colima in Mexico (Linsley, 1958). Linsley, MacSwain and Smith (1955) have also noted the noisy flight of matinal bees of the andrenine subgenus *Onagrandrena* which visit *Oenothera* before sunrise to the accompaniment of a buzzing suggestive of certain anthophorids. However, a significant aspect of this behavior which is not mentioned in the literature, so far as we have been able to ascertain, is that this loud buzzing is only produced after sunset and before sunrise. In the presence of light the same species become much more quiet fliers. We have now observed this abrupt change in several species of *Onagrandrena* and *Tetralonia,* and in *Colletes stepheni* Timberlake.

LITERATURE CITED

Bingham, C. T. 1897. Hymenoptera, I. Fauna of British India. London. 579 pp.

Linsley, E. G. 1958. Ecology of solitary bees. Hilgardia (in press).

Linsley, E. G., J. W. MacSwain and R. F. Smith. 1955. Observations on the nesting habits and flower relationships of some species of *Melandrena.* Pan-Pacific Ent., 31:173-185.

Williams, F. X. 1927. Notes on the habits of the bees and wasps of the Hawaiian Islands. Proc. Hawaiian Ent. Soc., 6:425-464.

BOOK REVIEW

Checklist of the millipeds of North America, by Ralph V. Chamberlin and Richard L. Hoffman, Smithsonian Institution, Washington, 1958. 236 pp.

This annotated checklist of the Class Diplopoda north of Mexico includes some 749 species and subspecies and 200 genera, which fall into 11 orders. It is a careful, creditable piece of work, but the user should be aware that the lack of data has left many gaps, that many of the listed species will fall into synonymy, and that many other species, especially micromillipeds and millipeds from the Western United States, are still undescribed. With the exception of the genus *Abacion,* the arrangement of which is based on the unpublished work of the junior author, all groups have been recorded largely as they have been published. The authors have wisely listed both native and introduced species, for some of the latter have become so well established in our parks and gardens that they are the only ones that many urban collectors ever see.

It is hoped that this checklist, which is the first published since 1893, will stimulate the collection of specimens and the preparation of many local checklists. Serious investigators will find the field uncrowded, for our knowledge of this interesting class of arthropods lags 50 or more years behind that of the Insecta.—NELL B. CAUSEY, University of Arkansas

A PRELIMINARY LIST OF THE APHIDS OF MISSOURI

MORTIMER D. LEONARD
Washington, D.C.

Dr. James B. Kring of the Connecticut Agricultural Experiment Station recently called my attention to his paper in the Journal of the Kansas Entomological Society, 28(2):64-66, 1955, entitled "Some Aphid and Host Plant Records From Missouri." The collections on which Dr. Kring's paper is based were made by him in Kansas City, Missouri, during the summer of 1950, while he was an Instructor in Biology in Rockhurst College. Notes on 34 species plus one new unnamed species are included.

Dr. Kring's list reminded me that I had long had in my files records of determinations of aphids collected mostly at Columbia, Missouri, by Paul Hayhurst, from October, 1904, to June, 1905. This material, in alcohol, had been deposited by him in the Cornell University collection together with a considerable number of collections made in New York from June, 1905, to October, 1906. In 1936 I sent all these specimens to Dr. A. N. Tissot of the University of Florida who, during that year, put the aphids on slides and made determinations of as much of the material as possible. The slides were divided among the collections of Cornell University, Dr. Tissot, and the writer.

The aphids collected by Hayhurst (at Columbia, Missouri, except as otherwise noted) total fifty-one species. Of these, nine were recorded by Kring. There are also included in the following list records of twenty-six species of aphids from Missouri which have been supplied by Dr. Wilbur R. Enns of the Department of Entomology, University of Missouri. Six of these are in Kring's list; ten of the species were previously collected by Hayhurst. Included also are records of 21 new species described from Missouri by Monell and records of seven other species recorded by Monell in literature as found in Missouri. Some records by Riley, Thomas and Pergande are also included.

The total number of species herein recorded for Missouri is 113 from 126 food plants. Careful collecting and subsequent study of the material might eventually reveal three times this number of species in the state. Records by Hayhurst are followed by the symbol (H) and those by Kring by (K).

My sincere thanks are due Miss Louise M. Russell of the Agricultural Research Service, United States Department of Agriculture, Washington, D.C. for most helpfully reviewing the manuscript of this paper. My appreciation is also due to Dr. S. F. Blake, Senior Botanist, Crops Research Division, Agricultural Research Service, United States Department of Agriculture, and members of his staff for modernizing a number of the plant names used chiefly by Monell and Hayhurst.

JOSEPH TARRIGAN MONELL. Among the earliest, if not indeed the earliest, records of aphids in Missouri are those by Joseph Tarrigan Monell, who by profession was a civil mining engineer, having graduated from Washington University at St. Louis in 1881. He was born in St. Louis in 1859

and died there in 1915. Monell published five papers on aphids between 1878 and 1882, during nearly all of which period he was a volunteer assistant to C. V. Riley, then State Entomologist of Missouri. These papers contained the descriptions of one new genus and 32 new species, together with redescriptions and notes on several other species nearly all of which were recorded from Missouri. An excellent account of his life and accomplishments, including a full page portrait, was published by John J. Davis in Entomological News, 26(8):380-383, 1915, and a shorter obituary note, also by Davis, in the Journal of Economic Entomology, 8(5):503, 1915. Prof. Davis, of Purdue University, Lafayette, Indiana, has written to me that he has in his possession the slides of all of Monell's types, as well as the slides of all Monell's extensive collections of aphids made during his long career as an engineer. The latter contain so many records from Missouri that it has not been possible to examine them for inclusion in this paper. It is planned, however, to publish these records in a subsequent issue of this journal, as a supplement to the present list.

PAUL HAYHURST. I can find no information about Paul Hayhurst until his registration as a freshman in the University of Missouri in September, 1900, except that he was born in Kansas City, Missouri, on November 14, 1878. He received the A.B. degree in 1904, having taken a considerable number of credit hours in entomology. From 1905 to 1907 he was an Assistant Entomologist at Cornell University where he was also registered in the Graduate School, and from June, 1907, to July, 1908, he was Special Agent and then Agent and Expert, Bureau of Entomology, U.S. Department of Agriculture. In 1908-1909 he was Instructor in Economic Entomology, Bussey Institution, Harvard University, and from 1909 till sometime in 1912 Assistant Entomologist and then Entomologist in the University of Arkansas. He is reported then to have gone to the Virginia Truck Experiment Station, but the records of that station do not show that he was ever employed there. I have been unable to learn anything about Hayhurst's whereabouts or activities during all the years between 1912 and his death, in December 1946, which was reported to the Alumni Office of Cornell University. His career as an entomologist was brief and migratory, but he accomplished a considerable amount in a short time and it is felt fitting to put on record these few facts that could be learned about him.

Following is a list of publications by Hayhurst:

1909. Quack Grass (*Agropyron*), a host of the hessian fly. Jour. N.Y. Ent. Soc., 2(3): 231-234.

1909. Observations on a gall aphid (*Aphis atriplicis* L.). Ann. Ent. Soc. Amer., 2(11): 88-89, pl. XV.

1909. Observations on two species of Hyalopterus (Aphididae). Jour. N.Y. Ent. Soc., 17(3):108-115, pl. I.
(The three above papers are "Contributions from the Department of Entomology, Bussey Institution, Harvard University, Nos. 4, 5 and 6 respectively.)

1909. Aphid Technique. Ent. News, 20:255-260.

1911. The San Jose scale and how to control it. Univ. Arkansas Bull. 107, pp. 368-394 (with J. Lee Hewitt as senior author).

1911. Diseases of apple trees and fruit caused by fungi and insects. Univ. Arkansas Bull. 109, pp. 411-445.

LIST OF APHIDS

Amphorophora crataegi (Mon.). Original description (in *Siphonophora*). "On the underside of leaves of *Crataegus intricata* (*coccinea*) St. Louis, Mo." U.S. Geol. Geog. Survey Bull. 5:20, 1879.

Amphorophora hayhursti Mason. The type (USNM Cat. No. 26372) is a single alate viviparous female received from Paul Hayhurst, collected at Columbia, with the following note: "On leaves of *Ribes gracile*, very rare: general color green." The collection date is not given but the specimen and note were recieved in Washington, D.C., Dec. 12, 1906.

Amphorophora sensoriata Mason. On canes of raspberry (*Rubus* sp.), 10 Aug. 1950 (K).

Amphorophora sonchi Oestl. 11 Oct. 1904, on *Ribes gracile* (H).

Anoecia querci (Fitch). "Found on the roots of *Panicum glabra* (now *Digitaria ischaemum*) and other grasses by H. Pergande, at St. Louis, Mo., in November" (as *Schizoneura panicola* Thos.). Eighth Report State Ent. Ill., by Cyrus Thomas, p. 138, 1879. 8 May 1905, on *Cornus stolonifera* (H).

Anuraphis bakeri (Cowen). 16 May 1905, on *Crataegus intricata* (*coccinea*) (H). In flight 3 July 1950 and on leaves of red clover (*Trifolium pratense*) 25 Dec. 1949 (K). Columbia, 25 April 1954, on red clover (Russell det., G. W. Thomas coll.).

Anuraphis cardui (L.). 29 Apr. 1905, on *Prunus angustifolia* (H). On leaves and flower heads of thistle (*Circium* sp.), 11 Aug. 1950 (K).

Anuraphis maidi-radicis (Forbes). Worth, 5 June 1956, on corn roots (G. W. Thomas coll. and det.). "Very heavy on small grain sorghum in extreme southeast area where 80-100 percent of plants had 500-1,000 per plant. Lady beetles building up rapidly (Kyd, Thomas)." CEIR 8(28):603 July 11, 1958.

Anuraphis rosea Baker. Boonville, 10 June 1956; Exeter, 15 May 1952 (G. W. Thomas coll.); Kelso, Feb. 1944 (H. Diebold coll.)—all on apple.

Aphis sp. 18 Oct. 1904, on *Teuchrium canadense* (H).

Aphis calendulicola Mon. (Original description) "On the underside of leaves of *Calendula micrantha*. July; St. Louis, Mo." U.S. Geol. Geog. Survey Bull., 5:23, 1879.

Aphis coreopsidis (Thos.) (as *Siphonophora*). St. Louis, Oct., on heads and flower stalks of Spanish needle, *Coreopsis aristosa* (now *Bidens*) (Th. Pergande coll.). Eighth Report State Ent. Ill., by Cyrus Thomas, p. 59, 1879.

Aphis cornifoliae Fitch. "On the underside of leaves of *Cornus florida* and *C. paniculata* (now *racemosa*), June-July; St. Louis, Mo." Monell, U.S. Geol. Geog. Survey Bull., 5:25, 1879.

Aphis crataegaefoliae Fitch. "On *Crataegus coccinea* (now *intricata*), St. Louis, Mo., June." Monell, in U.S. Geol. Geog. Survey Bull., 5:25, 1879.

Aphis debilicornis G.&P. 19 May 1905, on *Helianthus tuberosus* (H).

Aphis fabae Scop. (det. as *rumicis* L.) 1 May 1905, on *Euonymus atropurpureus* (H). On leaves of burdock (*Arctium* sp.), 26 July 1950 (K).

Aphis folsomii Davis. On leaves and stems of Boston ivy (*Parthenocissus* sp.), 10 July 1950 (K).

Aphis gossypii Glov. Mar. 1905, on *Begonia* sp. (H). Madison, 1 July 1954 (Chas. Trussel coll.), on watermelon; Miller, 2 July 1948, on cucumber (Ward Rhodes coll.).

Aphis helianthi Mon. (Original description) "On stems and leaves of *Helianthus*, St. Louis, Mo." U.S. Geol. Geog. Survey Bull., 5:26, 1879. 9 Oct. 1904, on *Ambrosia trifida* (H).

Aphis illinoisensis Shimer. 9 May 1905, on *Vitis riparia* (H). On leaves and terminals of grape (*Vitis* sp.) (K).

Aphis medicaginis Koch. "On *Caragana arborescens, Melilotus italica, Robinia viscosa*. July; St. Louis, Mo." Monell, U.S. Geol. Geog. Survey Bull., 5:24, 1879.

Aphis monardae Oestl. 2 May 1905, on *Monarda fistulosa* (H).

Aphis nerii Fonsc. (Original description of *A. lutescens* Mon.). "On *Asclepias syriaca*. July, September. St. Louis, Mo." (Also from Iowa and Illinois.) U.S. Geol. Geog. Survey Bull., 5:23, 1879.

Aphis oestlundi Gill. 16 May 1905, on *Oenothera biennis* (H).

Aphis pawneepae Hottes. (Original description in Proc. Biol. Soc. Wash., 47:3, 1934.) Morphotype, oviparous female, Osage City, 29 Aug. 1931, on *Cercis canadensis* (A. C. Burill coll.).

Aphis pilosicauda G.&P. On leaves of thistle (*Circium* sp.), 11 Aug. 1950 (K).

Aphis pomi DeG. In C. V. Riley's Second Annual Report on the Noxious, Beneficial and Other Insects of the State of Missouri, 1870, he states on p. 6 (concerning *Aphis mali*) that "a prodigious number of lice were produced as soon as the apple buds burst." 5 June 1905, on *Pyrus japonica* (H).

Aphis pseudohederae Theob. On leaves and stems of ivy (*Hedera helix*), 16 June, 16 July 1950 (K).

Aphis rubicola Oestl. 11 May 1905, on wild raspberry (*Rubus* sp.) (H).

Aphis rubifolii (Thos.). 29 Sept. 1904, on blackberry (H).

Aphis sambucifoliae Fitch. St. Louis, 5 June 1905, on *Sambucus canadensis* (H). On leaves of elder (*Sambucus* sp.), 18 July 1950 (K).

Aphis spiraecola Patch. On leaves and terminals of *Spiraea* sp., 26 July 1950 (K).

Aphis thaspii Oestl. One slide in USNM, det. as this species, labelled "Columbia, Mo. Hayhurst on *Thaspium aureum.*" 1 May 1905, on *Thaspium aureum* (now *Thaspium trifoliatum* var. *flavium* Blake), det. by Tissot with query, from apterae only (H). In the USNM are 7 slides of this little-known species (described from Minnesota in 1887), from Rochester, Minnesota, 20 July 1907 (Geo. Ainslee coll.).

Aphis varians Patch. 30 Apr. 1905, on *Ribes missouriense* and *A. varians* Patch. 11 Oct. 1904, on *Ribes gracile* (H), the latter det. with query.

Aphis viburniphila Patch. 7 May 1905, on *Viburnum prunifolium* (H).

Brevicoryne brassicae (L). 20 Oct. 1904, on turnip (H). Columbia, 1 Feb. 1949, on cabbage, mustard and turnip in greenhouse (L. Haseman coll., Russell det.).

Calaphis betulaecolens (Fitch). St. Louis, 5 June 1905, on *Betula alba* (H).

Capitophorus wasatchii Knlt. In flight, 30 July 1950 (K).

Cavariella aegopodii (Scop.). (Original description of *Rhopalosiphum salicis* Mon.) "On underside of leaves of *Salix lucida, S. nigra,* and *S. babylonica,* June, St. Louis, Mo." U.S. Geol. Geog. Survey Bull., 5:26, 1879.

Chaitophorus viminalis Mon. On leaves of willow (*Salix* sp.), 2 Aug. 1950 (K).

Cinara tujafilina (delG.). In colonies on bark of arborvitae, 22 June 1950 (K). Columbia, 24 Aug. 1939, on arborvitae (L. Haseman coll., Mason det.).

Colopha ulmicola (Fitch). (Original description of *Tetraneura graminis* Mon.) "On leaves of *Aira* (now *Deschampsia*) *cespitosa* and *Agrostis plumosa* (species identification dubious), enveloped in a thick cotton-like secretion. Sept.-Oct., St. Louis, Mo., Springfield, Mo., Neosho, Mo." Can. Ent., 14(1):14, 1882. Life history discussed at some length, at least partly in reference to the latitude of St. Louis. In and under bark of the white elm (*Ulmus americana*). Riley, *in* U.S. Geol. Geog. Survey Bull., 5:9, 1879.

Drepanaphis acerifoliae (Thos). 29 Apr. 1905 on *Acer saccharinum* (H). St. Louis, received subsequent to the summer of 1878 from Pergande. Eighth Report State Ent. Ill., by Cyrus Thomas, as *Siphonophora,* p. 47, 1879.

Drepanaphis kansensis Smith. On leaves of hard maple (*Acer* sp.), 26 June 1950 (K).

Drepanaphis monelli (Davis). Types from St. Louis, June 13, 1906, and June 30, 1908, on *Aesculus glabra.*

Eriosoma americanum (Riley). (Original description as *Schizoneura.*) St. Louis and Kirkwood, on *Ulmus americana,* U.S. Geol. Geog. Survey Bull., 5:4, 1879. Mountain View, 30 May 1946, on *Ulmus* sp. (H. F. Koonce coll.).

Eriosoma crataegi (Oestl.). 3 Oct. 1904, on *Crataegus* sp. (H). University City, 8 Aug. 1946, on *Crataegus* sp. (Edith Murel coll.).

Eriosoma lanigerium (Hasumann). In pseudo galls on American elm, 15 June 1950 (K). Washburn, 22 Aug. 1949, on apple (Logan Arnold coll.).

Eriosoma rileyi (Thos.). Described by C. V. Riley from Missouri as *Eriosoma ulmi* n. sp. in the First Annual Report on the Noxious, Beneficial and Other Insects of the State of Missouri, p. 124, 1869. It is here stated that "every white elm (*Ulmus americana*) tree around the court house in St. Louis was more or less affected last summer." 2 June 1905, on *Ulmus americana* (H).

Eulachnus rileyi (Wms.). 17 May 1905, on *Pinus nigra* (H).

Forda formicaria Heyden. (det. as *occidentalis* Fbs.). 16 Mar. 1905, host unrecorded (H).

Forda olivacea Rohwer. 3 Mar. 1905, on grass roots (H).

Gypsoaphis oestlundi Hottes. (Original description of *Aphis lonicerae* Mon.) "On young twigs and leaves of *Lonicera.* Living in colonies, covered with an abundant pulverulent secretion; May-July, St. Louis, Mo." U.S. Geol. Geog. Survey Bull., 5:26, 1879.

Hammamelistes spinosus Shimer. 20 May 1905, on cultivated birch (H).

Hyalopterus atriplicis L. "The common *Aphis* on *Chenopodiaceae* appears to be identical with the European. Its occurrence in America has not been previously noticed. St. Louis, Mo." Monell, U.S. Geol. Geog. Survey Bull., 5:25, 1879.

Hyalopterus hyperici (Mon.). (Original description, as *Aphis.*) "Living in colonies on the young twigs and underside of leaves of *Hypericum kalmianum,* to which species it seems to be confined." U.S. Geol. Geog. Survey Bull., 5:25, 1879.

Hysteroneura setariae (Thos.) "Leaves and spikes of *Panicum proliferum* (E. C. Leonard of the National Herbarium says this species has been confused with *P. dichotomiflorum* by the older authors.) August-September, St. Louis, Mo." Monell, U.S. Geol. Geog. Survey Bull., 5:23, 1879. On leaves of bluegrass (*Poa* sp.), 18 July 1950 (K). Palmyra, on red plums (J. H. Tate coll.), 17 June 1948; Greenfield, 9 May 1942, on peach (R. T. King coll.).

Longistigma caryae (Harris). In flight, 15 June 1950 (K). Columbia, 1 Nov. 1937, on hickory; May 15, 22 and 24, 1957, on sycamore and 28 Aug. 1957, on pin oak—all W. R. Enns coll.; Sedalia, 17 May 1939 (N. L. Enns coll.). A synonym of this species, *Lachnus longistigma,* was described from St. Louis by Monell, in The Valley Naturalist, 1(6):21, July, 1878. This description was reprinted in full in the Eighth Report of the State Entomologist of Illinois (Third Annual Report of Cyrus Thomas), pp. 119-120, 1879. Following the description, Monell states "Since the above was written I have found this *Lachnus* living in great abundance on the underside of the branches of Linden, a few miles west of St. Louis. The newly born larvae have the head, thorax and legs yellowish and the abdomen greenish."

Macrosiphoniella sanborni Gill. On leaves and stems of *Chrysanthemum* sp., 17 July 1905; in flight, 10 Aug. 1950 (K).

Macrosiphum sp. (close to *illini* var. *sangamonensis* H.&F.) May 8, 18 and 25, 1905, on *Helianthis tuberosus* (H).

Macrosiphum ambrosiae (Thos.). On leaves of ragweed (*Ambrosia trifida*), 26 July 1950 (K). Columbia, 1 Aug. 1951, on garden flowers (L. Haseman coll., Russell det.).

Macrosiphum calendulae Mon. (Original description, as *Siphonophora.*) "On stems of *Calendula micrantha.* June-July, St. Louis, Mo." U.S. Geog. Survey Bull., 5:21, 1879.

Macrosiphum calendulella Mon. (Original description, as *Siphonophora.*) "On the underside of leaves of *Calendula micrantha.* July, St. Louis, Mo." U.S. Geol. Geog. Survey Bull., 5:19, 1879. (Moier, Schweiz. Ent. Gessel. Mitt., b. 27, h. 4, p. 349, Dec. 3, 1954, states this is *Myzus persicae.*)

Macrosiphum erigeronensis (Thos.). 16 Oct. 1904, on *Erigeron canadensis* (H). On stems and leaves of daisy fleabane (*Erigeron annuus*), 26 July 1950 (K).

Macrosiphum granarium (Kirby). 18 Oct. 1904, host unrecorded (H). Nevada, 15 April 1954, on barley and wheat (G. W. Thomas coll. Russell det.).

Macrosiphum illini H.&F. In flight and on ground cherry (*Physalis* sp.), 10 July 1950 (K).

Macrosiphum liriodendri (Mon.). (Original description, as *Siphonophora.*) "On *Liriodendron tulipifera,* June, July; St. Louis, Mo." U.S. Geol. Geog. Survey Bull., 5:20, 1879. St. Louis, 5 June 1905, on *Liriodendron tulipifera* (H).

Macrosiphum pisi Kalt. 18 Oct. 1904, on red clover; 22 Dec. 1904, host unrecorded (H). Marceline, 15 June 1950, on alfalfa (S. P. Campbell coll.).

Macrosiphum rosae (L). 31 Oct. 1904, on rose (H). On leaves and stems of roses (*Rosa* sp.), 25 June 1950 (K).

Macrosiphum rudbeckiae (Fitch). "This species has been taken at St. Louis on *Vernonia novebaracensis, V. lindheimeri, Solidago rigida, S. serotina* (now *Gigantea leiophylla*), *Bidens chrysanthemoides* (now *laevis*), *Ambrosia trifida, Circium arvense,*

Silphium perfoliatum, S. integrifolia, and *Cacalia suaveolens."* Monell, U.S. Geol. Geog. Survey Bull., 5:21, 1879. 30 Oct. and 22 Nov. 1904, on *Solidago canadensis;* St. Louis (det. with query), 5 June 1904, on *Silphium perfoliatum* (H). Columbia, 1 Aug. 1915, on goldenglow (L. Haseman coll., Russell det.).

Macrosiphum sanguinarium H.&F. 28 May 1905, on *Sanguinaria canadensis* (H).

Macrosiphum solanifolii (Ashm.). On stems and leaves of tomato (*Lycopersicon esculentum*), 18 Aug. 1950; on stems and leaves of daisy fleabane (*Erigeron annuus*), 26 July 1950; on leaves of rhubarb (*Rheum officinale*), 18 Aug. 1950 (K).

Macrosiphum sonchellum (Mon.). (Original description, as *Siphonophora sonchella.*) "On *Sonchus oleracea.* July, St. Louis, Mo. This species is remarkable for the habit of at once dropping to the ground when disturbed." U.S. Geol. Geog. Survey Bull. 5:21, 1879. 11 Oct. 1904, on *Sonchus oleraceus* (H).

Macrosiphum tulipae Mon. (Original description, as *Siphonophora.*) "On petals and stigma of tulips, April; St. Louis, Mo." U.S. Geol. Geog. Survey Bull., 5:19, 1879.

Macrosiphum venaefuscae (Davis) (det. with query). 15 Oct. 1904, on *Rumex obtusifolius* (H).

Monellia caryae (Mon.). (Original description, as *Callipterus.*) "Leaves of walnut, hickory, and pecan. June-July. St. Louis, Mo." U.S. Geol. Geog. Survey Bull., 5:31, 1879.

Myzocallidium riehmi Börner. Columbia and Glasgow, 10 June 1956, on sweetclover (G. W. Thomas coll., det. Russell).

Myzocallis n. sp. (det. Bourdreaux). In flight 12 Aug. and on oak (*Quercus* sp.), 19 Aug. 1950 (K).

Myzocallis sp. 11 Oct. 1904, on *Quercus imbricaria* (H).

Myzocallis alhambra Davidson. 25 Oct. 1904, on *Quercus imbricaria.*

Myzocallis asclepiadis (Mon.). (Original description, as *Callipterus.*) "May-August. Very common at St. Louis on *Asclepias cornuti* (now *syriaca*) and *A. obtusifolia* (now *amplexicaulis*)." U.S. Geol. Geog. Survey Bull., 5:29, 1879. Albany 2 June 1922, on milkweed (A. C. Burrill coll.). Note taken from G. F. Knowlton's, Utah Agr. Exp. Sta. Mimeo Series, 387:3, April 1953.

Myzocallis bella (Walsh). In flight, 16 June 1950 (K).

Myzocallis betulaecolens (Mon.). (Original description, as *Callipterus.*) "On the underside of birch leaves. June. St. Louis, Mo." U.S. Geol. Geog. Survey Bull., 5:30, 1879.

Myzocallis discolor (Mon.). (Original description, as *Callipterus.*) "Underside of leaves of *Quercus bicolor.* St. Louis, Mo., May." U.S. Geol. Geog. Survey Bull., 5:30, 1879.

Myzocallis punctata (Mon.). Original description, as *Callipterus.*) "On the underside of leaves of *Quercus bicolor.* May-June. St. Louis, Mo." U.S. Geol. Geog. Survey Bull., 5:30, 1879. (*Callipterus hyalinus* n. sp., on the same page and with the same locality and dates, is a synonym. Recorded from *Quercus imbricaria.*)

Myzocallis punctatella (Fitch). In flight, 19 Aug. 1905 (K).

Myzocallis ulmifolii (Mon.). On leaves of American elm (*Ulmus americana*), 21 June 1950 (K).

Myzocallis walshii (Mon.). (Original description, as *Callipterus.*) "May-July. St. Louis, Mo. On the underside of leaves of *Quercus rubra."* U.S. Geol. Geog. Survey Bull., 5:29, 1879.

Myzus persicae (Sulz.). 18 Mar. 1905, 2 collections on radish; 29 Mar. 1905, on pansy; 15 Jan. 1905, on *Coleus* sp.; Mar. 1905, on *Begonia* sp. (H). Columbia, 1 Feb. 1949, on cabbage, mustard, turnips and 10 Jan. 1949, on *Impatiens* sp. (all in greenhouse, L. Haseman coll., Russell det.); Sikeston, 28 Mar. 1957, on *Lamium amplexicaule* and plantain (P. L. Adkisson coll., Russell det.).

Myzus porosus (Sand.). 19 May 1905, on wild rose (H).

Neosymydobius albasiphus (Davis). Kirkwood, 5 June 1905, on *Quercus alba* (H).

Neothomasia populicolus (Thos.). On leaves of cottonwood (*Populus* sp.), 24 June 1950 (K).

Pemphigus nortonii Maxson. In flight, 3 July 1950 (K).

Pemphigus populi-caulis Fitch. In twisted petiole leaf galls on cottonwood (*Populus sargenti*), 20 June 1950 (K).

Pemphigus populi-transversus Riley. (Described from Missouri, in U.S. Geol. Geog. Survey Bull., 5:15, 1897.) In petiole galls on cottonwood (*Populus sargenti*), 13 July 1950 (K).

Periphyllus negundinis (Thos.). 26 Apr. 1905, on *Acer negundo* (H).

Phorodon humuli (Schr.). (Original description of *Phorodon mahaleb* Mon.) "This European species has been very abundant at the Missouri Botanical Gardens, St. Louis. I believe it has not before been definitely reported as occurring in the United States." Can. Ent. 14(1):13, 1882.

Prociphilus fraxinifolii Riley. (Original description, as *Pemphigus.*) "Tolerably common at St. Louis, Mo. (Riley, Monell). Infesting the terminal leaves of *Fraxinus americana* and *F. sambucifolia* (now *nigra*) from spring till late summer and producing a twisted curl thereof." U.S. Geol. Geog. Survey Bull., 5:18, 1879.

Prociphilus tessellata Fitch. (Original description of *Pemphigus acerifolii* Riley.) "June-July; St. Louis, Mo. (Riley)." U.S. Geol. Geog. Survey Bull., 5:16, 1879.

Pterocomma smithii (Mon.). On bark of willow (*Salix* sp.), 2 July 1950 (K).

Rhopalosiphum sp. 19 May 1905, on pigweed (H).

Rhopalosiphum conii (Davidson). 14 Oct. 1904, on *Euonymus* sp.; St. Louis, 5 June 1905, on *Lonicera* sp. (H). Columbia, 14 May 1954, on *Lonicera sempervirens* (W. R. Enns coll., Russell det.).

Rhopalosiphum fitchii (Sand). (As *Aphis prunifolii* Fitch.) "At St. Louis, this species occurs only on varieties of native plums." Monell, U.S. Geol. Geog. Survey Bull., 5:26, 1879. 4 May 1905, host unrecorded (H). On sudangrass (*Sorghum* sp.), 18 July 1950 (K).

Rhopalosiphum maidis (Fitch). In flight, 17 Aug. 1950 (K). Carrollton and Marshall, July-Sept. 1957, on sorghum; Ozark, 4 Sept. 1957, on Atlas sorgho (G. W. Thomas coll.); "Statewide on corn (Haseman).

Rhopalosiphum pseudobrassicae (Davis). St. Charles, 23 Oct. 1950, on rape (Jim Evans coll., Russell det.).

Rhopalosiphum rufiabdominalis Sasaki (=*R. subterraneum* Mason). Oregon, 15 Feb. 1950, on wheat (Herbert Koch coll., Russell det.).

Rhopalosiphum rhois Mon. St. Louis, 5 June 1905, on *Rhus chinensis.* In flight, 10 July 1950 (K).

Stegophylla quercicola (Mon.). (Original description as *Callipterus?*) "St. Louis, Mo., on oak." U.S. Geol. Geog. Survey Bull., 5:31, 1879.

Therioaphis maculata (Buckton). Stoddard Co., 14 June 1956, on alfalfa (G. W. Thomas coll., Russell det.). "Statewide in 1956"—G. W. Thomas. Ranged from 0 to 135 per sweep of net in alfalfa, in south central Missouri; none in southeast area (Kyd, Thomas). CIER, 8(36):780, 1958.

Therioaphis trifolii (Mon.). 5 Oct. 1904, on *Trifolium pratense* (H). Columbia, 4 June 1956, and Worth Co., 13 Sept. 1956, on red clover (G. W. Thomas coll., Russell det.).

Toxoptera graminum (Rond.). Marshall, 6 May 1949, on bluegrass (G. D. Jones coll.); Nevada, 15 April 1954, on wheat (G. W. Thomas coll.); Oregon, 15 Feb. 1950, on wheat (Herbert Koch coll.); Springfield, 1 May 1950, on orchardgrass—all det. Russell.

Trifidaphis phaseoli (Pass.). Bragg City, May 1956, on roots of seedling cotton (P. L. Adkisson coll., Russell det.).

Tychea panici Thos. (Original description.) St. Louis, October, on roots of *Panicum glabrum* (now *Digitaria ischaemum*) (Pergande coll.).

FOOD PLANT LIST

Acer negundo (Box Elder)
  Periphyllus negundinis
Acer saccharinum (Silver Maple)
  Drepanaphis acerifoliae
Acer sacharum (Hard Maple)
  Drepanaphis kansensis
Aesculus glabra (Ohio Buckeye)
  Drepanaphis monelli
Agrostis plumosa (Bentgrass)
  Colopha graminis
Alfalfa—see *Medicago sativa*
Amaranthus sp. (Pigweed)
  Rhopalosiphum sp.
Ambrosia trifida (Giant Ragweed)
  Aphis helianthi
  Macrosiphum ambrosiae
Apple—see *Pyrus malus*
Arborvitae—see *Thuja*
Arctium sp. (Burdock)
  Aphis cardui
Artichoke, Jerusalem—see *Helianthus tuberosus*
Asclepias sp. (Milkweed)
  Myzocallis asclepiadis
Asclepias amplexicaulis
  Myzocallis asclepiadis

Asclepias syriaca (Common Milkweed)
Aphis nerii
Myzocallis asclepiadis
Ash—see *Fraxinus*
Barley—see *Hordeum vulgare*
Beebalm—see *Monarda*
Begonia sp. (Begonia)
Aphis gossypii
Myzus persicae
Bentgrass—see *Agrostis*
Betula sp. (Birch, cultivated)
Hamamelistes spinosus
Myzocallis betulaecolens
Betula alba (Gray Birch)
Calaphis betulaecolens
Bidens laevis
Macrosiphum rudbeckiae
Birch—see *Betula*
Blackberry—see *Rubus*
Bloodroot—see *Sanguinaria*
Bluegrass—see *Poa*
Box Elder—see *Acer negundo*
Brassica sp. (Mustard)
Brevicoryne brassicae
Myzus persicae
Brassica sp. (Rape)
Rhopalosiphum pseudobrassicae
Brassica oleracea capitata (Cabbage)
Brevicoryne brassicae
Myzus persicae
Brassica rapa (Turnip)
Brevicoryne brassicae
Myzus persicae
Buckeye—see *Aesculus*
Burdock—see *Arctium*
Cabbage—see *Brassica oleracea capitata*
Cacalia suaveolens (Sweet-smelling Indian Plantain)
Macrosiphum rudbeckiae
Calendula micrantha
Macrosiphum calendulella
Aphis calendulicola
Caragana arborescens (Siberian Peashrub)
Aphis medicaginis
Carya sp. (Hickory)
Longistigma caryae
Monellia caryae
Carya illinoensis (Pecan)
Monellia caryae
Chaenomeles japonica (Japanese Flowering Quince)
Aphis pomi
Chrysanthemum sp. (Chrysanthemum)
Macrosiphoniella sanborni
Circium sp. (Thistle)
Anuraphis cardui
Aphis pilosicauda
Circium arvense (Canada Thistle)
Macrosiphum rudbeckiae
Citrullus vulgaris (Watermelon)
Aphis gossypii
Clover, Red—see *Trifolium*
Coleus sp. (Coleus)
Myzus persicae
Corn—see *Zea mays*
Cornus florida (Flowering Dogwood)
Aphis cornifoliae
Cornus racemosa
Aphis cornifoliae
Cornus stolonifera (Redosier Dogwood)
Anoecia querci
Cotton—see *Gossypium*
Cottonwood—see *Populus*
Crataegus sp. (Hawthorn)
Eriosoma crataegi
Crataegus intricata (Thicket Hawthorn)
Amphorophora crataegi
Anuraphis bakeri
Aphis crataegifoliae
Creeper—see *Parthenocissus*
Cucumber—see *Cucumis sativus*
Cucumis sativus (Cucumber)
Aphis gossypii
Currant—see *Ribes*
Dactylis glomerata (Orchardgrass)
Toxoptera graminum
Deschampia cespitosa (Tufted Hairgrass)
Colopha graminis
Dock—see *Rumex*
Dogwood—see *Cornus*
Elder—see *Sambucus*
Elm—see *Ulmus*
Euonymus sp. (Euonymus)
Rhopalosiphum conii
Euonymus atropurpureus (Eastern Wahoo)
Aphis fabae
Erigeron annuus (Daisy Fleabane)
Macrosiphum erigeronensis
Macrosiphum solanifolii
Erigeron canadensis (Horseweed Fleabane)
Macrosiphum canadensis
Evening Primrose—see *Oenothera*
Fleabane—see *Erigeron*
Flowering Quince—see *Chaenomeles*
Fraxinus americana (White Ash)
Prociphilus fraxinifolii
Fraxinus nigra (Black Ash)
Prociphilus fraxinifolii
Germander, American—see *Teuchrium*
Goldenglow—see *Rudbeckia laciniata*
Goldenrod—see *Solidago*
Gooseberry—see *Ribes*
Gossypium sp. (Cotton)
Trifidaphis phaseoli
Grape—see *Vitis*
Grass (unspecified)
Forda olivacea
Groundcherry—see *Physalis*
Hairgrass—see *Deschampsia*
Hawthorn—see *Crataegus*
Hedera helix (English Ivy)
Aphis pseudohederae

Helianthus sp. (Sunflower)
Aphis helianthi
Helianthus tuberosus (Jerusalem Artichoke)
Aphis debilicornis
Macrosiphum sp.
Henbit Deadnettle—see *Lamium amplexicaule*
Hickory—see *Carya*
Hordeum vulgare (Barley)
Macrosiphum granarium
Hypericum kalmianum (Kalm St. Johnswort)
Hyalopterus hyperici
Impatiens sp. (Jewelweed)
Myzus persicae
Indian Plantain—see *Cacalia*
Ironweed—see *Vernonia*
Ivy—see *Hedera helix*
Jewelweed—see *Impatiens*
Juglans sp. (Walnut)
Monellia caryae
Lamium amplexicaule (Henbit Deadnettle)
Myzus persicae
Liriodendron tulipifera (Tuliptree)
Macrosiphum liriodendri
Lonicera sp. (Honeysuckle)
Gypsoaphis oestlundi
Rhopalosiphum conii
Maple—see *Acer*
Medicago sativa (Alfalfa)
Macrosiphum pisi
Therioaphis maculata
Melilotus alba (White Sweetclover)
Myzocallidium riehmi
Melilotus italica
Aphis medicaginis
Milkweed—see *Asclepias*
Monarda fistulosa (Wildbergamot Beebalm)
Aphis monardi
Mustard—see *Brassica*
Oak—see *Quercus*
Oenothera biennis (Common Eveningprimrose)
Aphis oestlundi
Orchardgrass—see *Dactylis glomerata*
Panicum proliferum
Hysteroneura setariae
Pansy—see *Viola*
Parthenocissus sp. (Creeper)
Aphis folsomii
Peashrub, Siberian—see *Caragana arborescens*
Pecan—see *Carya illinoensis*
Physalis sp. (Ground Cherry)
Macrosiphum illini
Pigweed—see *Amaranthus*
Pine—see *Pinus*
Pinus nigra (Austrian Pine)
Eulachnus rileyi
Planetree—see *Platanus*
Plantago sp. (Plantain)
Mysus persicae
Plantain—see *Plantago*
Plantain, Indian—see *Cacalia suaveolens*
Platanus sp. (Sycamore or Planetree)
Longistigma caryae
Platanus occidentalis (American Planetree or Sycamore)
Longistigma caryae
Plum—see *Prunus*
Poa sp. (Bluegrass)
Aphis setariae
Toxoptera graminum
Populus sp. (Cottonwood)
Neothomasia populicola
Populus sargenti (Cottonwood)
Pemphigus nortonii
Pemphigus populi-caulis
Pemphigus populi-transversus
Prunus sp.
Aphis chetansapa
Hysteroneura setariae
Prunus sp. (Plum)
Hysteroneura setariae
Rhopalosiphum fitchii
Prunus angustifolia (Chickasaw Plum)
Anuraphis cardui
Pyrus japonica—see *Chaenomeles*
Pyrus malus (Apple)
Anuraphis rosea
Aphis pomi
Eriosoma lanigerum
Quercus sp. (Oak)
Myzocallis punctatella
Stegophylla quercicola
Quercus alba (White Oak)
Neosymdobius albasiphus
Quercus bicolor (Swamp White Oak)
Myzocallis punctata
Quercus imbricaria (Shingle Oak)
Myzocallis sp.
Myzocallis alhambra
Myzocallis punctata
Quercus palustris (Pin Oak)
Longistigma caryae
Quercus rubra (Red Oak)
Myzocallis walshii
Radish—see *Raphanus*
Ragweed—see *Ambrosia*
Rape—see *Brassica*
Raphanus sativus (Garden Radish)
Myzus persicae
Raspberry—see *Rubus*
Rheum officinale (Rhubarb)
Macrosiphum solanifolii
Rhubarb—see *Rheum*
Rhus chinensis (Chinese Sumach)
Rhopalosiphum rhois

Ribes gracile (Nepal Currant)
Amphorophora gracile
Amphorophora sonchi
Aphis varians
Ribes missouriense (Missouri Gooseberry)
Aphis varians
Rosa sp. (Rose)
Macrosiphum rosae
Myzus porosus
Rose—see *Rosa*
Rosinwood—see *Silphium*
Rubus sp. (Blackberry)
Aphis rubifolii
Rubus sp. (Raspberry)
Amphorophora sensoriata
Aphis rubicola
Rudbeckia laciniata (Goldenglow)
Macrosiphum rudbeckiae
Rumex obtusifolius (Bitter Dock)
Macrosiphum venaefuscae
Salix sp. (Willow)
Chaitophorus viminalis
Pterocomma smithiae
Salix babylonica (Babylon Weeping Willow)
Cavariella aegopodii
Pterocomma salicis
Salix lucida (Shining Willow)
Cavariella aegopodii
Salix nigra (Black Willow)
Cavariella aegopodii
Sambucus sp. (Elder)
Aphis sambucifoliae
Sambucus canadensis (American Elder)
Aphis sambucifoliae
Sanguinaria canadensis (Bloodroot)
Macrosiphum sanguinarium
Silphium integrifolium (Rosinweed)
Macrosiphum rudbeckiae
Silphium perfoliatum (Cup Rosinweed)
Macrosiphum rudbeckiae
Solidago canadensis (Canada Goldenrod)
Macrosiphum rudbeckiae
Solidago gigantea leiophylla (November Goldenrod)
Macrosiphum rudbeckiae
Solidago rigida (Stiff Goldenrod)
Macrosiphum rudbeckiae
Sonchus oleraceus (Common Sowthistle)
Macrosiphum sonchellum
Sorgho, Atlas—see *Sorghum*
Sorghum saccharatum (Atlas Sorgho)
Rhopalosiphum maidis
Sorghum sp. (Small Grain Sorghum)
Anuraphis maidi-radicis
Sorghum sudanense
Rhopalosiphum fitchii
Rhopalosiphum maidis
Sowthistle—see *Sonchus*
Spiraea sp. (Spiraea)
Aphis spiraecola
St. Johnswort—see *Hypericum*
Sudangrass—see *Sorghum*
Sumach—see *Rhus*
Sunflower—see *Helianthus*
Sweetclover, White—see *Melilotus alba*
Sycamore—see *Platanus*
Teuchrium canadense (American Germander)
Aphis sp.
Thaspium trifoliatum var. *flavium* Blake (formerly *aureum*)
Aphis thaspii
Thistle—see *Circium*
Thuja sp. (Arborvitae)
Cinara tujafilina
Thuja virginiana (Arborvitae)
Cinara tujafilina
Trifolium pratense (Red Clover)
Anuraphis bakeri
Macrosiphum pisi
Therioaphis trifolii
Triticum spp. (Wheat)
Macrosiphum granarium
Rhopalosiphum rufiabdominalis
Toxoptera graminum
Tulip—see *Tulipa*
Tulipa sp.
Macrosiphum tulipae
Tuliptree—see *Liriodendron tulipifera*
Turnip—see *Brassica rapa*
Ulmus sp. (Elm)
Eriosoma americanum
Ulmus americana (American Elm)
Colopha ulmicola
Eriosoma lanigerum
Eriosoma rileyi
Myzocallis ulmifolii
Vernonia lindheimeri (Ironweed)
Macrosiphum rudbeckiae
Vernonia noveboracensis (New York Ironweed)
Macrosiphum rudbeckiae
Viburnum prunifolium (Blackhaw Viburnum)
Aphis viburniphila
Viola tricolor hortensis (Pansy)
Myzus persicae
Vitis sp. (Grape)
Aphis illinoisensis
Vitis riparia (Riverbank Grape)
Aphis illinoisensis
Watermelon—see *Citrullus*
Wheat—see *Triticum*
Willow—see *Salix*
Zea mays (Corn)
Anuraphis maidi-radicis
Rhopalosiphum maidis

OBSERVATIONS ON THE BEHAVIOR OF BRASILIAN HALICTID BEES, VI, TROPICAL SPECIES[1]

CHARLES D. MICHENER[2] AND CARLOS ALBERTO CAMPOS SEABRA[3]

Previous parts of this series dealt principally with observations made on the southern Brasilian plateau, where, as summarized by Michener, Lange, Bigarella and Salamuni (1958a,b), winters are long and rather cold with temperatures falling below freezing, so that for three months or more there is very little activity of bees. The present paper deals instead with observations made in more tropical areas. Most of the data were gathered in the Floresta da Tijuca, on the mountains within the city of Rio de Janeiro. In this area winters are cooler than summers, but frost is unknown. Some of the observations were made at Guaruva, almost at sea level near the coast of the state of Santa Catarina. Although well south of the Tropic of Capricorn, this locality is at least much hotter than the plateau where the studies reported in previous parts of this series were made. In the case of *Chloralictus seabrai,* a few nests were found near Curitiba, Paraná, on the plateau, and information on them is included here in order to avoid dividing the account of the species.[4]

The data on the species considered in this paper are quite fragmentary but are of interest for comparison with data on halictine bees from areas with cold winters.

Chloralictus seabrai Moure

Although this is a rather small *Chloralictus,* superficially different from others by having dark wing tips, its bionomics are probably quite similar to those of *C. rhytidophorus* Moure, described in some detail previously (Michener and Lange, 1958f).

Nests were found at altitudes of 500 to 600 meters in the Floresta da Tijuca, Rio de Janeiro, in roadside banks as well as in flat ground at the sides of the roads themselves, for example along the Caminho do Humaitá. Many of the nests were isolated or in little groups of three or four, but in one bank a few dozen nests were found in an area of about four square meters. A few scattered nests were also found in the Bariguí roadside banks

[1] This is the last of this series of papers. References to the other parts will be found in the "Literature Cited."

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near Curitiba in the state of Paraná. The distribution of these nests was indicated by Michener, Lange, Bigarella and Salamuni (1958a,b).

There seems to be a quiescent period in winter even at Floresta da Tijuca, for on August 2, 1955, nests were not open at the surface. However, one or two were opened by accident during studies of the nests of other bees. The nest or nests opened consisted of burrows with empty cells and contained four female bees, all fertilized, with slender ovaries and with the wings and mandibles unworn or slightly so, the indices of wear (as used for *C. rhytidophorus* by Michener and Lange, 1958f) ranging from 2 to 4. While these bees were in old nests, it seems that the females also may overwinter in burrows newly constructed in the fall, for on May 13, 1956, at Bariguí, a burrow known to have been constructed recently was opened and found to contain a single unworn fertilized bee with slender ovaries.

It seems that, as in *C. rhytidophorus* Moure, new nests may be started at any season except winter. Females working in short simple burrows presumably recently started were found in the Floresta da Tijuca on November 28, January 9 (2 nests in areas dug out on November 28, hence certainly started since that date), March 7, and March 24.

As with *C. rhytidophorus,* bees of both sexes are probably produced throughout the active season. In the Floresta da Tijuca, nine pupae were found in various nests on November 28. Three of these were males, six females. The male producing and female producing cells were intermixed.

During the active part of the year the number of adult females per nest, in eleven nests properly studied, varied from 1 to 3, with a mean of 1.6. From this one may judge that the colonies average smaller than those of *C. rhytidophorus.* When a female works alone in a nest she doubtless performs all functions of nest maker, forager, and egg layer, as in solitary bees. However, in nests with more than one female, they differ in ovarian development and probably in behavior.

There is evidence that the female castes are about as similar as in *C. rhytidophorus.* All intergradations between queens and workers occur in ovarian development, and on dissection the females can be placed in five arbitrarily delimited groups (a, fertilized, most ovarioles enlarged; b, fertilized, two or three ovarioles enlarged; c, unfertilized, only one or two oöcytes enlarged; d, fertilized, ovaries slender; and e, unfertilized, ovaries slender), just as in that species. Only one bee of group c was found. During the active part of the year nests containing two or three bees had one queen (group a or b), the remainder workers (group c to e). We have little evidence of behavioral differences between queens and workers except that in midsummer (January 9) a series of nine females collected going in and out of nests were all in group e. Had queens been as active as workers outside their nests, there probably would have been some in this series. Average size differences exist between the castes. Lengths of forewings among 16 queens ranged from 4.1 to 4.4 mm. (mean, 4.197; its standard error, .0264). Among nine workers, lengths ranged from 3.8 to 4.2 mm. (mean, 3.97; its standard error, .049). The means are significantly different ($P<.001$). For these measurements, queens were recognized as individuals making their own nests alone (all of these were in groups a or b) or indi-

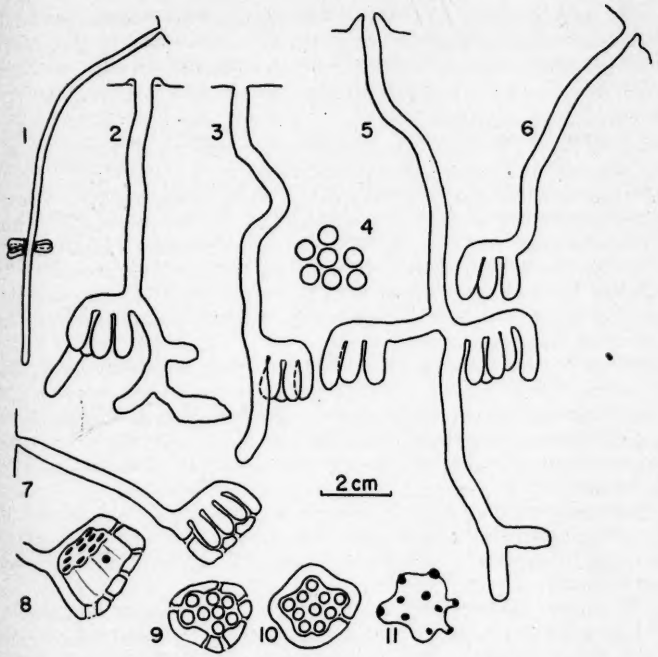


Fig. 1. Side view of nest of *Chloralictus guaruvae* Moure, October 30, 1955. The nest contained one adult female; in the five cells were prepupae and pupae. Figs. 2 and 3. Side views of nests of *Augochloropsis brachycephala* Moure, July 30, 1955. The nest contained no immature forms. The first contained two adult females and one male, the second, four adult females. Fig. 4. Top view of cell cluster of *A. brachycephala* showing arrangement of cells, July 30, 1955. Figs. 5 and 6. Side views of nests of *A. brachycephala*, November 27, 1955. Each contained one adult female. The left cluster of figure 5 consisted of unshaped tubes, the right consisted of four cells, one being provisioned, one with an egg, one with a large larva, and one with a mature larva, and at extreme right, an unshaped tube. The cluster in figure 6 consisted of two shaped cells with eggs and an unshaped tube. Figs. 7 to 11. Nests of *Augochlorodes turrifasciens* Moure, June 11, 1956. 7, side view of nest; 8, side view of cell cluster showing pillars at bases of cells and two lateral pillars, one broken and shown in black; 9 and 10, front views of cell clusters showing lateral pillars; 11, back views of cell cluster showing in black the pillars at bases of cells.

viduals of groups a or b in nests containing two or three bees, or overwintering bees which presumably would have started their own nests in the spring. All were fertilized. Workers were recognized by being worn bees having slight ovarian development and usually no sperm in the spermatheca. Unworn, unfertilized bees (which ordinarily have slender ovaries) were excluded from these measurements as such bees are often young and might become either queens or workers.

The nest structure is essentially as in *C. rhytidophorus,* except for smaller size due to the small size of the bee and fewer cells and less frequent branching due to smaller average nest populations.

Chloralictus guaruvae Moure

This species was studied only on one spring day, October 30, 1955, at Guaruva, Santa Catarina. Numerous nests were found in a small bank of clay soil in a brushy area. Some opened among grass plants at the top of the bank and extended nearly straight down, while others entered the face of the bank obliquely and turned downward (fig. 1). Some were closed, while others were open, and some had loose dirt at the entrances indicating recent excavation. Some were mere burrows being excavated, but most were unbranched burrows with four to six cells, close together (fig. 1), with large larvae or pupae in them. Each contained a single fertilized female bee with well worn mandibles.

If this is a social species like *C. rhytidophorus,* these were queen nests. As in that species and *C. stultus* (Cresson) in the United States, it is apparent that the overwintering females make new nests in the spring, construct and provision about five cells, and then cease work until these progeny mature. During this inactive period the nest often becomes closed at the surface.

One nest contained a large group of adjacent cells along a burrow that branched at least once. Probably this was made by two or more females that overwintered together and did not disperse before starting their reproductive activities.

In general the immature stages were older nearest the nest entrances and younger deeper in the soil, indicating that the uppermost cells were made and provisioned before the deeper ones. Pupae of both sexes were intermixed in the cell clusters. Of 22 pupae, 6 were males, and 16 were females.

Augochloropsis brachycephala Moure

Observations on this bee were made in the Floresta da Tijuca, mostly at an altitude of about 400 meters. The nests were in groups, often a dozen or more in an area half a meter square, in small banks along the road above Açude Solidão. Most were at a location only about one-fourth of a mile from the Açude.

This species is closely related to *A. diversipennis* (Lepeletier) whose bionomics was discussed by Michener and Lange (1958d). It differs from that species as studied on the southern Brasilian plateau not only in the form of the nest as described below but in the survival through the winter of males and unfertilized females, as well as of worn females (fertilized).

Nests were twice studied in winter, once on July 30, 1955, and again on June 11, 1956. On both occasions the weather was bad, so that the extent of winter activity of the adults was unknown. The nest entrances were open, however, and many had turrets, suggesting some winter activity. However, there were no immature stages in the nests, nor were there cells being provisioned. All cells were open and empty. The number of adults per nest ranged from one to four. A total of 10 males and 26 females were

found on our two winter visits. A few females were alone in simple burrows which they had probably started in the fall and would probably enlarge into nests with cells in the spring. Excluding such females, no nest was found to contain only one bee; numbers varied in seven carefully excavated nests from 2 to 4, with an average of 3.1. In the same nests, the number of males ranged from 0 to 2, average 1.0, while the number of females ranged from 1 to 3, average 2.1.

The ovaries of all the overwintering females were slender; as with *A. diversipennis*, very slender ovaries like those of young or overwintering *A. sparsilis* (Vachal) are unknown. Of 28 females dissected in winter (July 30 and June 11), 19 were unworn, four showed slight mandibular and wing wear, four were well worn, and one was much worn. All those that were worn were fertilized, but 12 of the 19 unworn females were unfertilized.

From these data it is clear that many unfertilized females, together with males that may fertilize them, pass through the mild winters of the Floresta da Tijuca.

Observations made during other seasons of the year (November 27, 1955, January 9 and February 22, 1956) show that most nests are then occupied by only a single adult female, although an occasional nest contains two. Among 19 females captured for dissection on February 22, three were worn but unfertilized, suggesting that they were workers. Unfortunately their nestmates were unkown, but it seems probable that in late summer a certain proportion of workerlike bees appears. On November 27 eggs and larvae of all sizes but no pupae were found in the cells. On the other dates mentioned all stages were found, including pupae of both sexes.

The nests consist of burrows sloping downward into the bank, and extending for 8 to 15 cm. from the entrances. The burrow diameters are about 5 mm. They are lined by soil taken from the cells or elsewhere; at least a lining one-fourth to one-half millimeter thick is of a different color from the surface soil. The burrows are often conspicuous because of the turrets at the entrances, which are sometimes as much as 1.5 cm. long. Even in winter small eroded turrets are often present, and in summer they are frequently large.

At depths of 5 to 12 cm. from the burrow entrance, the cell clusters were found. As shown in figures 2 to 6, these clusters may be just to one side of the main burrow or, less commonly, at the ends of lateral burrows two or three centimeters long. The cell clusters contain two to eight cells, not more than four of which are shaped, smoothed, and lined for use. The others, in clusters which we saw, always remained rough, and sometimes one or two of them were prolonged as short vertical burrows.

The cells were vertical, shaped as in other species of *Augochloropsis* (Michener and Lange, 1958d), 11 to 13 mm. deep, about 5.5 mm. in maximum diameter. Because of various colors of soil in the banks, it was easy to observe that the cells were lined with soil brought from other parts of the nest. The inner surface of this lining was beautifully smoothed as in other species and covered with a thin wax layer. The rectangular pollen mass and egg placement are as in other species of *Augochloropsis*.

From *A. diversipennis* this species differs in the shallow and more nearly vertical nests, as well as in the facts of the seasonal cycle described above. It resembles *A. diversipennis* in the usually small size of the cell clusters. Probably each is ordinarily constructed and provisioned by a single female, and once used, is abandoned, as in that species. However, as in *A. diversipennis,* the discovery of some workerlike individuals suggests that some cooperative social relationships exist. As has been shown elsewhere, such relationships are more highly developed in *A. sparsilis.*

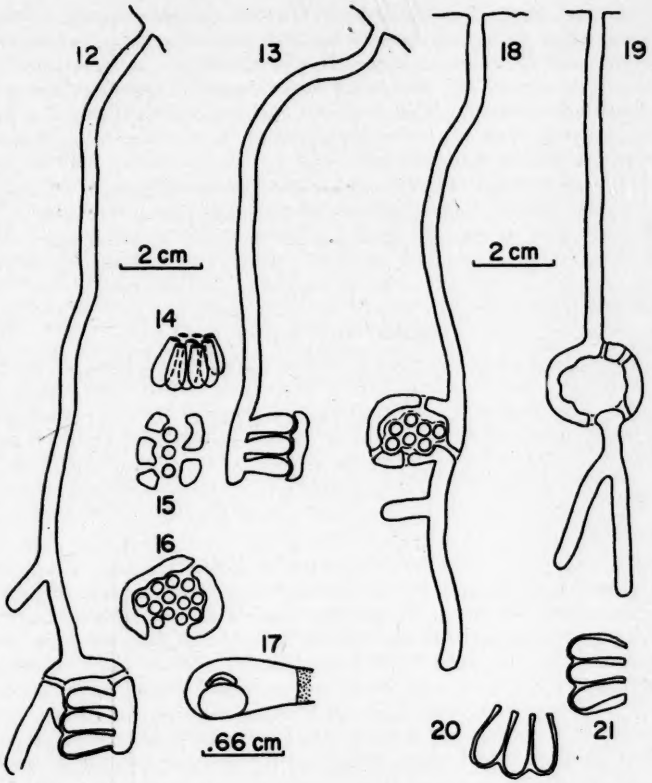
Augochlorodes turrifasciens Moure

This species was found nesting in a moist bank in the Floresta da Tijuca on June 11, 1956. All the information recorded below is based on data gathered on that day. Although it was winter (of the very mild sort that occurs near the margins of the tropical zone), adults of both sexes were flying about the nests and some cells were found which were being provisioned with pollen. In other cells young of all stages, eggs, larvae, and pupae of both sexes, were found.

As many as three adult females were found in a single nest. Because of lack of time, it was not possible to obtain complete nest populations which would have indicated something of the details of the social relationships. However, among nine females dissected, four were unworn, unfertilized, with slender ovaries and probably had recently emerged from their cells. Four others were slightly to well worn, were fertilized, and had ovaries in various degrees of enlargement. These appeared to be egg laying bees. A single individual had distinctly worn mandibles but was unfertilized and had slender ovaries. Evidently it was a workerlike individual such as have been described for *Augochlorella michaelis* (Vachal) and *Pseudaugochlora nigromarginata* (Spinola) (Michener and Lange, 1958c) and for *Augochloropsis sparsilis* (Vachal) (Michener and Lange, 1958d). The wing length of the workerlike individual was 4.8 mm.; that of the four egg layers ranged from 4.9 to 5.2 mm. The tendency of workerlike individuals to be smaller than other females is poorly documented but nonetheless suggested in the three other species listed above.

The nests consist of horizontal or sloping burrows penetrating the bank for depths of 4 to 10 cm. The burrows were about 4 mm. in diameter, narrowed to 2.5 to 2.8 mm. in diameter at the entrances, each of which is provided with a distinct earthen turret, which led to the specific name given the bee by Father J. S. Moure.

At its inner end the burrow opens into a chamber (figs. 7 to 10) in which the cell cluster is supported by pillars. Cell clusters examined contained from five to ten cells; the average number of cells in nine clusters was 7.0. The cells slant at an angle of about 40% from vertical (figs. 7 and 8), and the surfaces of the cell clusters slant correspondingly. The clusters are very delicate, for the earth walls between and around the cells range from .5 to 1.0 mm. in thickness, sometimes being as little as .25 mm. thick between cells and at the bases of the cells. The pillars that support the cell cluster are both at the bases of the cells and around the sides of the cluster, as indicated in figures 7 to 11. The cells are 9 to 10 mm. long, about 4 mm.



F.gs. 12 to 17. Nests of *Paroxystoglossa spiloptera* Moure, October 30, 1955. 12 and 13, side views of nests, the cell clusters shown in section; 14, top view of large cell cluster; 15, front view of cluster of three cells, such as is shown in figure 13; 16, front view of large cell cluster, such as is shown in figures 12 and 14; 17, side view of cell with pollen mass and egg. Figs. 18 to 21. Nests of *Paroxystoglossa seabrai* Moure, August 1, 1955. 18 and 19, front and back views of nests; 20, top view of cell cluster (section); 21, side view of cell cluster (section).

in maximum diameter, the entrances about 3 mm. in diameter. The flatter sides of the cells are downward (fig. 7). As in other halictines, the cells are lined with a thin layer of waxlike material.

Paroxystoglossa spiloptera Moure

Observations on this bee were all made near Guaruva, Santa Catarina, on October 30, 1955. Several nests were found in a sloping bank (surface at an angle of about 45°), which they penetrated to depths of 11 to 18 cm. The cells of the nests contained mostly prepupae and pupae (of both

sexes), although a few contained eggs. No growing larvae were seen. From this we judge that at the time of our visit a new period of activity was starting, after a time of inactivity. Nearly half of the nests examined were closed at the surface and found only by accident. Of eight nests examined, six contained only a single adult female, but two contained two such bees. Bees of one of these pairs were not dissected. In the other case, only one of the two females was fertilized.

The nest structure is similar to that of *P. jocasta* (Schrottky) (Michener and Lange, 1958b). Sometimes cells of the lower part or both the upper and lower parts of the cell cluster are not separated by an air space from the surrounding soil (figs. 12, 13, 15, 16). Some of the cells may be cut into undisturbed soil (fig. 12). This is suggestive of the situation in *P. andromache* (Schrottky), in which loose dirt often fills part of the space around the cell cluster (Michener and Lange, 1958c).

The orientation of the cells, their thin earthen walls, form, etc., are as in other species of this genus. Cells number three to twelve per cluster, the average number in seven clusters being 7.0. The cell entrances range from 3.0 to 3.25 mm. in diameter, and greatest cell diameters are about 5.0 mm., while their lengths (measured to the surface of the cluster) range from 8.5 to 15.5 mm. Cell clusters range from 12 to 20 mm. in outside diameter, while the cavities in which the clusters lie range from 18 to 25 mm. in diameter.

Paroxystoglossa seabrai Moure

This species, which is very similar to *P. spiloptera* discussed above, was studied in the Floresta da Tijuca. Most nests were in a patch of flat, bare, hard, shaded ground beneath trees near Açude Solidão, but some were scattered in similar ground along the Caminho do Humaitá. A few females caught in flight near the Açude resembled *P. spiloptera*. Material from a few nests at Vista Chineza, near the Floresta da Tijuca, was a mixture of *P. seabrai* and a form near *P. spiloptera*. Data on these nests are excluded from this report because of the probable mixture of species.

The nests were examined twice in winter, once on August 1, 1955, and again on June 11, 1956. On both occasions various nests were open to the surface of the ground but others were closed and found only by digging in areas known to have had nests previously or in areas near open nests. A total of 38 bees, 7 of them males, were found on these two winter visits. On June 11 one male pupa and one female pupa (but no other immature stages) were found in the cells, while on August 1 no immature stages were found, the cells being open and either empty or containing adult bees. Of 26 females taken from nests on these dates and dissected, 17 were fertilized while eight were not. All of the latter were unworn. Of the fertilized females, nine showed mandibular and occasionally wing wear, three having slightly worn and nine well worn mandibles. In June all of the females had slender ovaries, but on August 1, presumably in preparation for the onset of spring activity, a number of the fertilized females had swollen ovaries, in one case with an oöcyte 1.9 mm. long (eggs are about 2.2 mm. long). From one to four were found in a single nest. From these

data we can conclude that in the fall reproduction comes to a halt, the last new adults emerging in June, but that adults of both sexes and females of all stages of wear (hence probably all ages) overwinter in the nests and presumably continue their activities in the spring.

On September 20, November 14 and 27, 1955, and January 9 and February 22, 1956, samples of females flying over the nests were captured. Each sample consisted largely of bees with ovaries at least somewhat enlarged and with sperm cells in the spermatheca. All degrees of mandibular wear were found, and some unworn bees were found to be unfertilized on each date mentioned above. No demonstrable sequence of generations was evident. Young of all stages were found on November 27 and on each succeeding visit through February 22.

Two worn bees with slender ovaries were captured carrying pollen loads on the scopal hairs. Both were fertilized, but were presumably behaving in workerlike fashion. Nests excavated from September to February were usually inhabited by a single female, but occasionally two were found in a nest.

On November 14 most of the nests examined consisted of simple burrows being constructed. One contained two females. On November 27 some similar nests were found, as well as newly constructed cell clusters and, in other nests, old cell clusters in which cells were being reused, as in *P. jocasta* (see Michener and Lange, 1958b). On the same date, nests each containing a completed cell cluster with immature stages in the cells, and with the adult beside the cells, but the entrance completely closed, were opened by good fortune. These nests were like those of *P. spiloptera* described above. Pupae of both sexes were found on all summer dates when nests were opened; a total of eleven female and five male pupae were found. Perhaps there is a preponderance of females.

From these data we conclude that except during the winter months of June, July, and August, reproduction goes on more or less continually, with the generations completely overlapping and indistinguishable.

The nests consist of vertical burrows extending down 8 to 16 cm. in the hard, moist soil. At depths of 8 to 12 cm. each nest is enlarged to form a chamber containing a cluster of horizontal cells supported by several earth pillars, much as in *P. jocasta* (see Michener and Lange, 1958b). The extraordinarily thin earth walls of the cells are as in that species and others of the genus. Figures 18 to 21 illustrate those characteristics of the nests.

The number of cells ranges from 5 to 13 (average of seven, 7.3) in completed nests. The chamber is 18 to 25 mm. in diameter, the cell cluster 13 to 18 mm. in diameter. The cells are 15 to 16 mm. long, the part lined with wax only about 8 mm. long. In maximum width, the cells range from 5.5 to 6 mm., while the width of the cell entrances is about 3 mm.

CONCLUSIONS

In temperate climates winter destroys all but one stage, ordinarily the young adult fecundated female, of halictine bees. The result is that winter is a synchronizing influence that tends to cause all nests of any species to be in the same condition at any one time, at least in spring and early summer.

For some European species this is summarized by Noll (1931), although his conclusions based upon the literature concerning Chilean species were often probably erroneous.

On the warm temperate or subtropical southern Brasilian plateau, the same seems to be true of some species. For example, in *Pseudagapostemon*, only young fertilized females survive the winter. The same is perhaps true of some tropical species, e.g., *Chloralictus seabrai*.

In other species from the plateau, synchronization of life cycles among the nests of a population is poor because in winter, although immature forms disappear from the nests, adult males as well as females may survive, and the females may be young and unfertilized, young and fertilized, or in various stages of wear. Examples (selected from Michener and Lange, 1958a to f) are as follows: In *Augochloropsis sparsilis* (Vachal) males do not pass the winter while females of various ages but almost all fertilized and unworn or but slightly so survive. In *Pseudaugochlora nigromarginata* (Spinola) well worn females pass the winter, along with unworn ones. All or almost all are fertilized, and males probably do not survive the winter. Finally, in *Paroxystoglossa jocasta* (Schrottky) both sexes survive the winter and the females range from young and unfertilized to fertilized and well worn.

In the tropical locations mentioned in the present paper, most of the species studied have a period of winter quiesence like that of *P. jocasta*, but the rest of the year seems to be occupied by intermixed and indistinguishable generations. In such forms it would seem that the winter merely stops reproduction but that the adult population survives intact and goes on with its activities when spring arrives. This is the situation in *Paroxystoglossa seabrai* and *Augochloropsis brachycephala*. It may be that *Augochlorodes turrifasciens* carries on its reproductive activity throughout the winter, although our data on this species are unfortunately incomplete.

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A NEW ALLAPORUS FROM SOUTHERN TEXAS (Hymenoptera: Pompilidae)

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Several years ago, in the pages of this journal, I reviewed the known species of the pompilid genus *Allaporus* (1953, 26:26-31). All five species are uncommon in collections; all five occur in Mexico, and three of them enter southern United States. On a recent collecting trip to southern Texas I discovered a sixth species of the genus, very different from any other and by all odds the most attractively colored member of the group.

This new species bears considerable superficial resemblance to *elegantulus* Evans, the only other species of the genus possessing bifasciate wings and an obscurely banded abdomen. On the basis of wing venation, however, it falls in another complex, which I have called the *mexicanus*-group (*ibid.*, p. 26). Both sexes key readily to the fourth couplet of my key (p. 27), which contains *mexicanus* Evans and *amabilis* Evans. The male closely resembles that of *amabilis*, but differs in having the mandibles unspecialized, the subgenital plate less acutely pointed, and the parameres more bluntly rounded apically. The female also resembles *amabilis* in many respects, including the slender front femora and strongly rugose propodeum; however, the vertex is less acute, the posterior ocelli are much closer to the crest of the vertex than to one another, and the mandibles are unspecialized. The female differs from both *amabilis* and *mexicanus* in coloration.

Allaporus fascipennis new species

Female. Length of body 8 mm.; fore wing 5 mm. Head black, mandibles and apical margin of the clypeus dark ferruginous, scape and pedicel brownish ferruginous, remainder of antennae black; thorax black, including front coxae and upper posterior parts of middle and hind coxae, legs otherwise bright ferruginous, tarsi a bit dusky; abdomen bright ferruginous, posterior third of each of basal four tergites dusky ferruginous, giving the abdomen an obscurely banded appearance. Wings hyaline, the fore wing conspicuously twice-banded; basal band actually a large, nearly circular brown blotch over the lower half of the basal vein; apical band occupying entire apical third of wing, as far basad as middle of marginal and second submarginal cells. Entire body clothed with a dense, conspicuous pubescence (coarser than in *amabilis* or *mexicanus*), mostly silvery but grading into light brown on the upper front and the thoracic dorsum; pubescence on darker parts of basal abdominal tergites rather dark, but each tergite with a narrow apical band of conspicuously silvery pubescence. Body nearly devoid of erect hairs, but with a few very short ones on the front, thoracic dorsum, and coxae.

Mandibles unmodified, inner margin with two small teeth. Clypeus 1.8 times as broad as high, rather flat, apex broadly truncate. Front rather flat, the spatium frontale but little elevated; middle interocular distance .68 times transfacial distance; upper interocular distance .92 times lower interocular distance. Vertex barely elevated above eye-tops; posterior ocelli

closer to crest of vertex than to one another; postocellar line greater than ocello-ocular line as 9:7. First four antennal segments in a ratio of about 16:5:11:11.

Posterior half of propodeum with a series of rather strong transverse rugae; posterior, ventral region of mesopleura also with some fairly strong rugae which are perpendicular to posterior margin of mesopleura. Legs slender, front femora not at all incrassate; middle tibiae with scattered short, black spines, the other tibiae with a very few spines; tarsi with numerous short, black spines. Fore wing with marginal cell slender, fairly long; second submarginal cell sessile above, very slightly longer than high; third discoidal cell also slightly longer than high; basal vein unusually strongly arched. Hind wing almost exactly as figured for *A. toltecus* Evans (*ibid.*, p. 28, fig. 2). Apical segments of abdomen compressed, the apical sternite especially so.

Male. Length 6 mm.; fore wing 4.5 mm. Color entirely black; wings completely hyaline, veins dark brown. Pubescence rather fine, slightly coarser on posterior slope of propodeum and posterior part of hind coxae; pubescence silvery, grading into brownish cinereous on antennae, upper front and vertex, thoracic dorsum, apices of legs, apices of basal abdominal tergites, and all of abdomen beyond the third segment. Body virtually devoid of erect hairs except for a few minute ones on the front and pronotum.

Mandibles unmodified. Clypeus flat, punctate, 1.8 times as broad as high. Middle interocular distance .63 times transfacial distance; upper interocular distance 1.15 times lower interocular distance; vertex elevated in an even arc above the eye-tops; postocellar line greater than ocello-ocular line as 8:5. First four antennal segments in a ratio of about 9:3:5:6, segment three barely longer than thick. Longer spur of hind tibia .83 times length of hind basitarsus. Wing venation not differing noticeably from that of female.

Abdomen very slender. Subgenital plate slender, tapering to a subacute apex, strongly folded along median line, much as illustrated for *A. amabilis* Evans (*ibid.*, p. 28, fig. 9) but not as acutely pointed apically. Genitalia of the usual form of the genus and differing only slightly from the other species; parameres barely as long as the volsellae, more broadly rounded apically than in any other species of the genus; volsellae with sparse and rather strong setae, slightly exceeding the parapenial lobes, which in turn slightly exceed the slender aedeagus.

Holotype. Female, Shore of Laguna Madre, near Port Isabel, Cameron Co., Texas, May 10, 1958 (H. E. Evans and O. S. Flint). *Allotype.* Male, same data as type (both U.S. National Museum). The two specimens were collected almost simultaneously at about eleven in the morning, the female by Evans as it was walking on bare soil along the upper margin of the beach, the male by Flint in low, halophytic vegetation about 50 feet away.

THREE NEW SPECIES OF *HEBRUS* CURTIS FROM THE PHILIPPINE ISLANDS (Hemiptera: Hebridae)

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At the present time four species of the genus *Hebrus* Curtis have been collected and identified from the Philippine Islands. *H. balnearis* Bergroth has been taken near Los Baños, Laguna; *H. cruciatus* (Distant) in Montalban Gorge, Rizal Province; *H. haddeni* Porter from Mt. Makiling, Laguna; and *H. bergrothi* Horvath. I do not know of any specific Philippine locality of the latter species; however, it is listed by O. Lundblad as occurring in the Philippine Islands. Horvath described it originally from Takao, Formosa.

In a collection of Hebridae received for identification from Dr. Robert L. Usinger, new species of *Hebrus* were discovered and are here described.

Hebrus hoberlandti new species
(Plate I, figs. I, II, III, IV)

SIZE. Male: length, 1.75 mm.; width across humeri, 0.60 mm. Female: length, 1.90 mm.; width across humeri, 0.80 mm.

COLOR. Head testaceous, vertex and tylus darker, antennae with first and second segments testaceous, distal segments darker, compound eyes fuscous, ocelli ferreous, tubercles between compound eyes and antennae fuscous; pronotum ferrugineous, lighter on lateral edges of anterior lobe and anterior portion of posterior lobe; mesoscutum testaceous; scutellum with median portion testaceous, borders and longitudinal medial carina darker; hemelytra with proximal end of veins testaceous, distal ends ferrugineous, membrane fuliginous with pale irregular areas at distal ends and another bordering inner veins; abdomen ferrugineous, more or less concolorous. Underparts: Head with bucculae light testaceous, rostrum testaceous; sternal ridges light testaceous, remainder of sternum darker; legs testaceous, darker at distal ends of femurs and proximal ends of tibiae, tarsi testaceous; venter testaceous, darker than sternae.

STRUCTURAL CHARACTERISTICS. Head much longer than broad, vertex with medial longitudinal sulcus, sulcus with rows of hairs along inner borders, frons and tylus tumid, tubercle approximately midway between compound eye and antenna, antennae five-segmented with annulations between segments II-III and IV-V; first antennal segment extending approximately one-fourth its length beyond tip of tylus; antenniferous tubercles with an acute tubercle; pronotum approximately one-third wider than long, with medial longitudinal sulcus, sulcus depth variable but deep on anterior lobe and evanescent on posterior lobe, the two lobes demarcated by an irregular row of coarse pits, both lobes with scattered pits; collar bounded posteriorly by row of pits, humeral angles strongly angulated; mesoscutum prominent; scutellum more than twice as wide as long, with median longitudinal carina, lateral margins nearly straight and elevated, apex deeply excavated; hemelytra short, extending approximately one-half

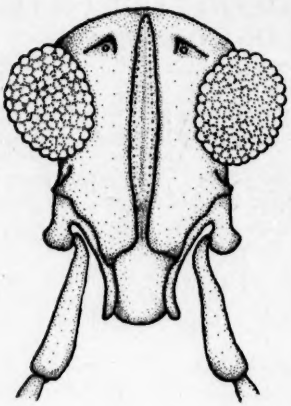

FIG. I

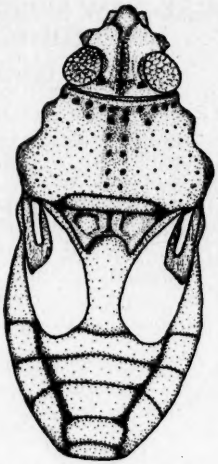

FIG. II

FIG. III

FIG. IV

PLATE I

Hebrus hoberlandti n. sp. I, head of female allotype. II, female allotype, dorsal aspect. III, paramere of male holotype. IV, genital capsule of male holotype.

length of abdomen; abdomen with prominent connexivum. Underparts: bucculae prominent, produced at proximal end; rostrum extending to center of first segment of venter; sternal ridges reduced on prosternum, prominent on mesosternum and metasternum; parameres of males curved sharply upward at distal end, hook short and stout.

COMPARATIVE NOTES. Near *H. angolensis* Hoberlandt but may be readily separated from that species by the parameres of the males. *H. angolensis* male holotype was collected along the bank of the river Kassï and the female allotype was taken along the bank of the river Tshikapa near Dundo, Lunda, North East Angola.

LOCATION OF TYPES. Holotype male and allotype female, Mt. Maquiling, P. I., VII-19-1936, R. L. Usinger. Holotype and allotype in the collection of Dr. Robert L. Usinger, Berkeley, California. One paratype female in the collection of the author. Type locality, Mt. Maquiling, near Los Baños, Luzon, P. I.

DATA ON DISTRIBUTION. Known only from type locality. There were two

males and two females available for study but one male was accidentally destroyed during the study.

This species is named in honor of Dr. Luvík Hoberlandt, National Museum, Praha, Czechoslovakia.

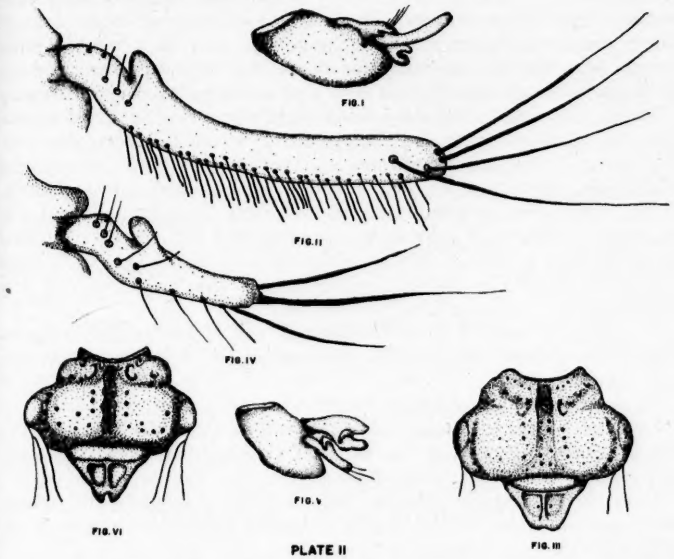

PLATE II

Hebrus drakei n. sp. I, genital capsule of holotype male. II, paramere of holotype male. III, thorax of holotype male.

Hebrus harrisi n. sp. IV, paramere of male holotype. V, genital capsule of male holotype. VI, thorax of male holotype.

Hebrus drakei new species

(Plate II, figs. I, II, III)

SIZE. Male: length, 1.98 mm.; width across humeri, 0.88 mm.

COLOR. Head fuscous, compound eyes ferrugineous, ocelli ferreous, first and second segments of antennae testaceous, distal segments darker; pronotum fuscous, humeri darker, collar lighter, posterior border of posterior disc lighter; mesoscutum fuscous, concolorous; scutellum fuscous, darker than pronotum and mesoscutum; hemelytra with veins fuscous, base of membrane fulvous, distal two-thirds fumous, oval pale spot at distal ends of veins and another near the midpoint of apex; connexivum fuscous. Underparts; bucculae testaceous, rostrum testaceous, sternal ridges testaceous, median portion of metasternum fuscous, pleura fuscous, legs testaceous, distal ends of middle and hind femurs and proximal ends of middle and hind tibiae darker; venter fuscous, concolorous.

STRUCTURAL CHARACTERISTICS. Head nearly as wide as long, vertex without medial longitudinal sulcus; first segment of antenna extending approxi-

mately one-half its length beyond end of tylus, segments I, II, and III approximately equal in length, IV shorter than III, and V shorter than IV, annulations between segments II-III and IV-V; pronotum with medial longitudinal sulcus, having scattered pits along its inner borders; humeri angulate and impressed within by a row of punctures or pits, discs demarcated by irregular rows of pits, collar bounded on posterior border by row of deep pits; mesoscutum prominent; scutellum more than twice as wide as long, only slightly excavated at apex, lateral edges upturned and incurved, medial longitudinal carina with a pit on each side, at approximately midlength; hemelytra with inner veins slightly produced at claval angles, veins and membrane with scattered golden pubescence. Underparts: bucculae strongly produced at proximal end, rostrum reaching first segment of abdomen, sternal ridges well developed on mesosternum and metasternum, evanescent on prosternum, first segment of venter with mid-ventral notch; parameres of male long, extending well beyond end of genital capsule, slightly upcurved, with thumb-like process near base, tuft of hairs proximal to thumb-like process, irregular rows of elongate setae along ventral side, coarse elongated setae at distal end.

COMPARATIVE NOTES. Near *H. comatus* D. and H. but genital structures of males are notably different. The type locality of *H. comatus* is Mesilla Dam, New Mexico.

No females of *H. drakei* were available for study.

LOCATION OF TYPE. Holotype male, Montalban, P. I., VII-24-1936, R. L. Usinger. In the collection of Dr. Robert L. Usinger, Berkeley, California. Type locality, Montalban, Rizal Province, P. I.

DATA ON DISTRIBUTION. Known only from type locality. This species was named in honor of Dr. Carl J. Drake, a long time student of the family Hebridae.

Hebrus harrisi new species
(Plate II, figs. IV, V, VI)

SIZE. Male: length, 2.00 mm.; width across humeri, 0.90 mm.

COLOR. Head fuscous, first and second segments of antennae fulvous, distal segments darker, compound eyes fusco-rufous, ocelli ferreous; pronotum fuscous, lighter on posterior border of posterior lobe; mesoscutum fusco-testaceous; scutellum fusco-piceous; hemelytra with veins fuscous, claval area with basal three-fourths white, distal one-fourth fulginous, membrane light fulginous with irregular white areas at distal ends of veins and near center of distal end. Underparts: bucculae light testaceous, rostrum testaceous, pronotum fusco-testaceous, mesosternum and metasternum fuscous, legs testaceous, distal ends of femora and proximal ends of tibiae darker, venter fuscous, concolorous.

STRUCTURAL CHARACTERISTICS. Head distinctly longer than wide, vertex without medial longitudinal sulcus, first segment of antennae extending approximately one-half its length beyond tip of tylus, tylus tumid; pronotum with medial longitudinal sulcus, sulcus deep on anterior lobe, evanescent on distal border of posterior lobe and with six pairs of pits along lateral borders, collar with row of punctures on posterior border, humeri angulated, impressed within by row of punctures; mesoscutum

prominent; scutellum with medial longitudinal carina, lateral edges upturned and incurved, apex notched; hemelytra with inner veins slightly produced at claval angle, membrane extending to distal end of abdomen, connexivum upturned. Underparts: bucculae prominent, produced at proximal end, rostrum extending approximately to center of metasternum, sternal ridges prominent on mesosternum and metasternum, evanescent on prosternum; parameres of male elongate, extending slightly beyond genital capsule, ventral side nearly straight, irregular rows of long setae along ventral and lateral surfaces, several long coarse setae at distal end, thumb-like process approximately midway on dorsal surface.

COMPARATIVE NOTES. Near *H. buenoi* D. and H. but can be readily separated from this species. *H. buenoi* has a deep sulcus in the vertex of the head. This character is lacking in *H. harrisi*. The parameres of the males are also unique.

LOCATION OF TYPES. Holotype male, Montalban, P. I., VII-24-1936, R. L. Usinger. In the collection of Dr. R. L. Usinger, Berkeley, California. Type locality, Montalban, Rizal Province, Luzon, P. I.

No females of the species were available for study.

DATA ON DISTRIBUTION. Known only from the type locality. This species is named in honor of Dr. Halbert M. Harris.

EFFECTS OF MALATHION AND PARATHION ON EJECTION OF YOUNG FROM GRAVID FEMALE SPOTTED ALFALFA APHIDS[1]

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The purpose of this study was to investigate the effects of malathion and parathion on reproduction of the spotted alfalfa aphid *Therioaphis* (*Pterocallidium*) *maculata* (Buckton). The thought occurred that these chemicals at certain concentrations might stimulate ejection of young from gravid female aphids. Smith (1946) found that mature female green peach aphids, which were sprayed with DDT and had dropped from their host plant and were subsequently shriveled from lack of food, nevertheless produced normal offspring after three days. Sun (1945) reported that mature females of *Aphis rumicis* L. treated with low concentrations of rotenone produced more young than control aphids that were dusted with talc. In the study reported herein, two dosage levels of insecticides were used. The usually-recommended rates for parathion of 2 oz. per acre and malathion at 8 oz. per acre as well as half these dosages were tested.

Gravid female aphids were placed in a one-square-foot box, where they

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were sprayed with an atomizer until they had received the appropriate dosage level. The aphids were observed for ejection of young and were timed as to how long they lived after being sprayed (Table I). Four separate groups of 20 gravid female aphids, placed on alfalfa, were given the following four respective treatments (equivalent rate per acre): malathion 4 ounces, malathion 8 ounces, parathion 1 ounce, parathion 2 ounces, and again observed (Table I).

TABLE I. Effects of malathion and parathion upon ejection of young from gravid female spotted alfalfa aphids. Manhattan, Kansas. 1957.

Treatment	Insecticide and equivalent ounces per acre		Av. no. hrs. gravid female aphids lived after exposure	No. of young ejected per female
Sprayed with half-dosage in a 1 sq. ft. box	malathion	4	4.6	0
	parathion	1	1.7	0
Sprayed with recommended dosage in a 1 sq. ft. box	malathion	8	1.1	0
	parathion	2	0.6	0
Sprayed with half-dosage on alfalfa	malathion	4	7.8	0
	parathion	1	3.3	0
Sprayed with recommended dosage on alfalfa	malathion	8	3.7	0
	parathion	2	2.5	0
Check (untreated)	.....	....	....	2-9

Another phase of the experiment was to spray the aphids in the box, leave them to walk around in the box exposed to the residue for different periods of time, then place them on untreated alfalfa. There they were observed as to the number of young they ejected and how long they lived after being sprayed (Table II).

TABLE II. Effects on gravid female spotted alfalfa aphids of exposure to malathion and parathion at different intervals of time before being placed on clean alfalfa. Manhattan, Kansas. 1957.

Minutes of exposure before placed on clean alfalfa	Av. no. hrs. lived when exposed to				No. of young ejected per female*
	Malathion		Parathion		
	4 oz.	8 oz.	1 oz.	2 oz.	
10	7.5	1.8	6.5	1.1	0
15	8.0	1.5	4.0	1.3	0
20	5.5	0.8	1.7	0.6	0

*Unsprayed gravid females on untreated alfalfa produced young during this entire experiment.

Results conclusively show that not a single young aphid was produced by, or ejected from, gravid female aphids under any of the treatments, in contrast to the production of young by females in the untreated check. Apparently there is no stimulus to perpetuation of the species caused by field application of these two chemicals.

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CONCERNING THE GENUS *HYNESIONELLA* POISSON AND A NEW SPECIES FROM SOUTH AFRICA (Heteroptera: Gerridae)[1]

HERBERT B. HUNGERFORD AND KYUICHI MATSUDA

In 1949 Dr. R. Poisson established this genus for his new species *Hynesionella aethiopica* (Bull. Soc. Ent. France, 1949, No. 6, pp. 83-85, figs. 3a, 3b, 3c). For our study of this genus Dr. W. E. China of the British Museum kindly loaned us a female specimen determined by him as *Hynesionella aethiopica* bearing the labels "Ethiopia, Suk Suk R., 7°43′ N, 38°38′ E., 8. 11-1944" and "N. Hynes Coll. B.M. 1955-67." The genus was named for this collector. In the material before us for study we have found another species that belongs to this genus, and we describe it below. It comes from East Cape Province, South Africa, and this extends the distributional range of this genus considerably.

Hynesionella omer-cooperi new species

(Plates 1 and 2)

Size: Apterous male 2.27 mm. long; 1.22 mm. wide. Apterous female 3.15 mm. long; 1.76 mm. wide.

Color: Black, covered for the most part by grayish pile, the median section of mesonotum in apterous forms less pilose and often shining; lateral margins of mesonotum with bluish pile. Head black, with a reddish yellow U-shaped figure that borders eyes and rear margin of head. Pronotum with a flavous, more or less oval median spot; sides and venter with white pile. Antennae and legs black. Proacetabula yellowish.

Structural characteristics: Relative lengths of antennal segments of male: 1st:2nd:3rd:4th::65:50:40:44, of female:80:50:43:48. Eyes in apterous form not quite overlapping one half of lateral margins of prothorax. Front and rear margins of pronotal disc nearly straight, rear margin slightly convex. Mesonotal disc somewhat flattened but higher in the middle, its anterior margin slightly concave in both sexes; posterior margin slightly concave in male, convex in female; laterally margined by a ridge and elevated caudally. Metanotum declivent, its rear margin distinct in female and medially obliterated in male. Mesosternal plate as wide and as long as second ventral abdominal segment. Omphalium completely absent. Relative lengths of leg segments of male shown in table I.

TABLE I. The relative lengths of leg segments of male *H. omer-cooperi.*

	Femur	Tibia	1st tarsal	2nd tarsal	Total tarsal length
Front leg	86	66	7	33	40
Middle leg	208	280	90	90	180
Hind leg	215	90	12	38	50

Front femur hairy beneath, that of male as shown in plate II, fig. E. Male genital segments large and curiously formed as shown in plate II, fig.

[1] Contribution No. 993 from the Department of Entomology, University of Kansas. This paper is a by-product of a project aided by a grant from the National Science Foundation.

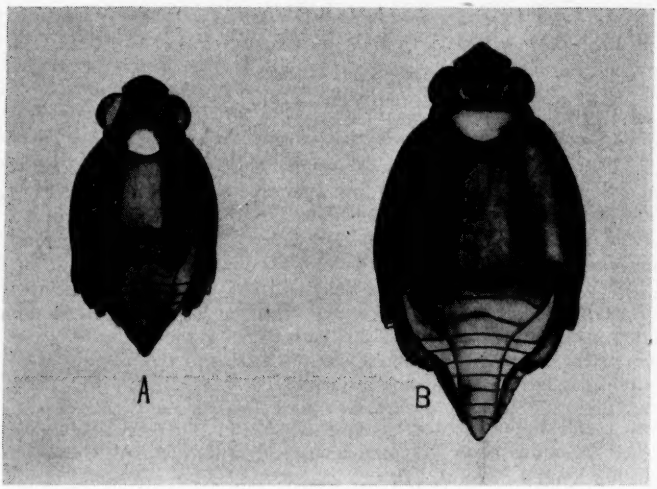

PLATE I

Hynesionella omer-cooperi Hungerford and Matsuda. A. Male. B. Female.

A. Paramere unrecognizable. Last ventral abdominal segment of female as long as two and a half preceding segments, and last abdominal tergite not as long as two preceding tergites together.

Types: Holotype male, "Albany, E. Cape Province, Africa, May 3, 1956 (J. Omer-Cooper)"; allotype female, "Qumbu, E. Cape Province, Africa, May 10, 1956 (J. Omer-Cooper)"; one female paratype taken with the holotype, three female paratypes taken together with the allotype and one from Maclear, E. Cape Province, Africa, May 9, 1956 (J. Omer-Cooper). All the types are in the Snow Entomological Museum, University of Kansas.

Comparative notes: The description of *Hynesionella aethiopica* gives the length of male as 3 mm. and of the female 3.25 mm. Dr. Poisson says of the male antenna that the first segment is slightly swollen and incurved, 1.3 times as long as second segment, which is 1.7 times as long as segment three; segments three and four subequal. Stating the antennal formula in another way for comparison with our new species: 1st:2nd:3rd:4th::13:10:5.9:5.9. In 1951, replying to an inquiry about the relative lengths of leg segments, Dr. Poisson kindly sent the data shown in table II for *Hynesionella aethiopica.*

TABLE II. The relative lengths of leg segments of *H. aethiopica.*

	Femur	Tibia	Tarsus (1 + 2)
Front leg	13	10	5.5
Middle leg	50	45	21 + 11?
Hind leg	34.5	13	6

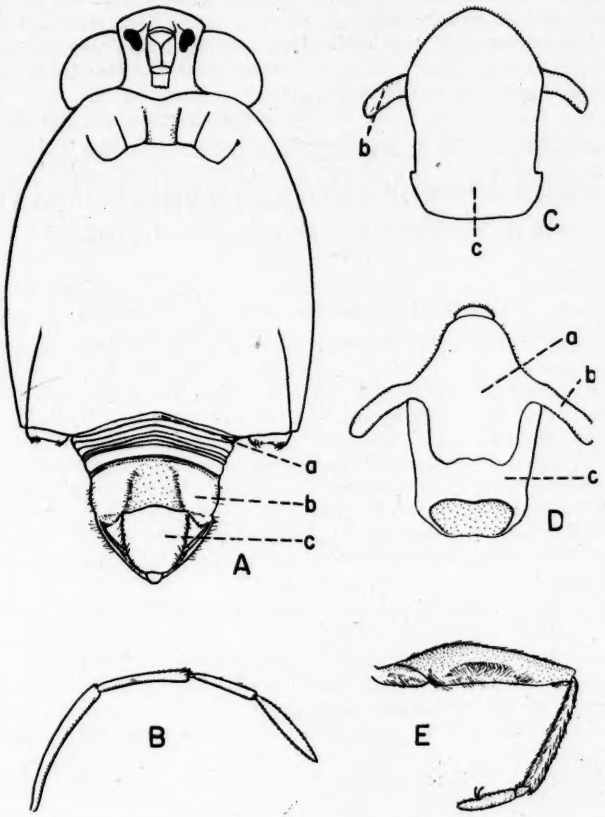

PLATE II

Hynesionella omer-cooperi Hungerford and Matsuda. A. Ventral view of male showing: a, metasternal plate; b, eighth sternite; c, pygophore. B. Female antenna. C. Ventral view of the male ninth segment showing: b, horn of suranal plate; c, pygophore. D. Dorsal view of suranal plate of male ninth segment showing: a, suranal plate; b, horn of suranal plate; c, pygophore. E. Male front leg.

From Dr. Poisson's published figures it is apparent at once that the shape of the front femur and of the horns on the suranal plate of the male are different in this new species. The female of *Hynesionella aethiopica* Poisson that Dr. China sent us has the rear margin of the mesonotum straight. The two species of this genus may be separated as follows:

A. Anterior femur of male broadest beyond a deep incision in its lower margin. Horns of suranal plate of male pointed. Caudal margin of mesonotal disc straight in female. ..... *H. aethiopica* Poisson

AA. Anterior femur of male without an incision on its lower margin. Horns of suranal plate of male of uniform width and rounded at tip. Caudal margin of mesonotal disc convex in female. .... *H. omer-cooperi* Hungerford and Matsuda

CONCERNING THE GENUS *LIMNOGONUS* AND A NEW SUBGENUS (Heteroptera: Gerridae)

By

HERBERT B. HUNGERFORD AND RYUICHI MATSUDA[1]

The genus *Limnogonus* Stål was described in 1868 in Hemiptera Fabriciana, pages 132-133, to include *L. hyalinus* (Fabricius) and *L. fossarum*. To this genus Stål also referred his species *Gerris discolor, G. parvula* and *G. franciscana*. Since then quite a number of species have been described and assigned to this genus. All species unquestionably belonging to *Limnogonus* have a shining pronotum and either two short parallel yellow lines on the anterior lobe of the pronotum or a round yellow spot on it, and thus they fall into two quite distinct groups. Both groups are found in the Old and New World and deserve subgeneric names. There are a few dull-colored, non-shining species from Africa, assigned to *Limnogonus*. They may have to be removed, upon further study.

Limnogonus s. str. comprises medium sized gerrids having a shining black pronotum margined by a yellow line, usually with a median longitudinal yellow line running most of its length and with two short longitudinal yellow lines on the anterior pronotal lobe. In the winged form, the humeri are far behind the middle of the pronotum, and in the wingless form the pronotum is not reduced but completely covers the mesonotum. The front femora and mesopleura are moderately long. *Limnogonus hyalinus* (Fabricius), the type species, and *Limnogonus fossarum* (Fabricius) are typical of this subgenus.

We propose the name *Limnogonellus* as a new subgeneric name of *Limnogonus* for those smaller species which differ from the above by having in common a round yellow spot on the anterior lobe of the pronotum instead of two parallel, short longitudinal lines, the pronotum either margined or not margined by a yellow line, and lacking a distinct median longitudinal line. In winged forms the humeri are near the middle of the pronotum, and in wingless forms the pronotum may be reduced to the anterior lobe, exposing the mesonotum. The front femora and mesopleura are moderately short. The following species belong to this subgenus: *L. parvulus*

[1] Contribution No. 1037 from the Department of Entomology, University of Kansas This is a by-product of a project supported by a grant from the National Science Foundation.

(Stål) (type species), *L. lubricus* (White), *L. hesione* (Kirkaldy), *L. lotus* (White), *L. visendus* Drake and Harris, *L. celeris* Drake and Harris, *L. genticus* Drake and Harris. *L. parvulus* Stål is found in India, China, Burma, Ceylon, Java, and Madagascar, and the other species are New World forms.

OCCURRENCE AND RELATIVE ABUNDANCE OF CERTAIN NOCTUID MOTHS IN NORTHWEST ARKANSAS, FALL, 1957[1]

KEITH HARRENDORF[2]

Those species of Noctuidae commonly referred to as "cutworms" cause considerable economic damage to northwest Arkansas crops each year. Since several species are involved, it is important that those species present and their relative abundance be known.

Records of moth flights provided by light trap catches have long been used to give an indication of relative abundance, although there are limits to the reliability of this method, as shown by Cook (1928). The light trap, even if limited in reliability, furnishes the most practical method of determining population and relative abundance and is probably fairly reliable for indicating inter-annual variations in populations. The use of bait in the collection of moths is limited in reliability in somewhat the same manner as the light trap; however, it is also a practical method for gaining the information desired.

These two methods were employed in a qualitative and quantitative study of those species of noctuids present in northwest Arkansas in the fall of 1957. No records were taken of those species known *not* to be in the group commonly referred to as "cutworms."

METHODS

Light Trap Collections

Noctuid moths were collected from a light trap located near Fayetteville, Arkansas, beginning on October 1, 1957, and ending on December 6, 1957. The trap was of the black light type, equipped with four 15 watt florescent lamps and three galvanized baffles. The lamps were approximately five feet above the ground. A wide-mouthed, one gallon killing jar was attached to the base of the trap funnel. A circular screen wire cage was devised to fit within the jar and to extend to about one-half its depth. Five or six number 6 rubber stoppers soaked in carbon tetrachloride were placed in the jar beneath the screen cage. The rubber stoppers were replaced every other day with others that had been freshly soaked in carbon tetrachloride.

[1] Published with the approval of the Director of the Arkansas Agricultural Experiment Station. Study conducted in partial fulfillment of degree of Master of Science, University of Arkansas. The assistance of Dr. Lloyd O. Warren is gratefully acknowledged.

[2] Now Instructor of Entomology, University of Missouri.

Moths were removed from the trap each morning and sorted, counted, and recorded by lot number. Representative specimens were pinned for determination of species.[3]

Bait Line Collections

Moth collections from bait lines were made on five nights between October 30, 1957, and December 6, 1957. Two collections were made each night the bait line was operated, one beginning at 8:00 p.m. and one at 10:00 p.m.

A bait consisting of the following ingredients was used: seven small overripe bananas, one and one-half pounds of brown sugar, and one-half bottle of beer, mixed in a Waring blender. The bait was applied with a paint brush before dark to fence posts, tree trunks, and vineyard posts, covering about 25 to 30 square inches at each site.

Collection was done by placing a killing jar beneath the lowest moth on the bait, gently brushing it into the jar then moving to the next higher moth. This method is not entirely satisfactory, as some of the moths will escape regardless of the care taken. However, in this study, it was assumed that those lost escaped in proportion to their abundance as a species, and, therefore, the relative abundance of the species taken was considered reliable.

RESULTS

Light Trap Collections

A total of 3740 noctuid moths were recorded from light trap collections between October 1, 1957, and December 6, 1957, with 19 species being represented. The 12 most common species collected in order of their abundance in light trap catches is shown in Table I.

TABLE I. The 12 most common species of Noctuidae collected, in the order of their abundance in light trap catches, and the per cent total noctuids recorded. Fayetteville, Arkansas, Oct. 1 to Dec. 6, 1957.

Species	Number of moths	Per cent of total
1. *Pseudaletia unipuncta* (Haw.)	1548	41.39
2. *Feltia ducens* Wlk.	605	16.18
3. *Lacinipolia renigera* (Steph.)	549	14.68
4. *Agrotis gladiaria* Morr.	396	10.58
5. *Agrotis ypsilon* (Rott.)	220	5.88
6. *Laphygma frugiperda* (J. E. Sm.) and *Prodenia ornithogalli* Guen.[4]	83	2.22
7. *Agrotis venerabilis* (Wlk.)	66	1.76
8. *Amathes bollii* (Grt.)	60	1.60
9. *Feltia subterranea* (F.)	51	1.36
10. *Nephelodes emmedonia* (Cram.)	45	1.20
11. *Choephora fungorum* Grt. and Rob.	34	.91
12. *Platysenta sutor* (Guen.)	33	.88

The following species were taken at the light trap but are not included in Table I: *Anicla infecta* (Ochs.), *Peridroma margaritosa* (Haw.), *Sunira*

[3] Determinations by E. L. Todd, Taxonomist, United States National Museum.

[4] *Laphygma frugiperda* and *Prodenia ornithogalli* were recorded together as the writer was unable to distinguish between them at the time of collection.

biclorago (Guen.), *Leucania* sp., *Metaxaglaea viatica* (Grt.) and one unidentified species.

Pseudaletia unipuncta and *Agrotis ypsilon* were taken regularly during the entire period from October 1, 1957, through December 6, 1957. The maximum catch for both of these species was recorded on October 30, when 280 specimens of *Pseudaletia unipuncta* and 63 specimens of *Agrotis ypsilon* were taken from the trap.

Specimens of *Feltia ducens* and *Lacinipolia renigera* were taken from October 1 to the first week in November, with peak occurrence during the first two weeks in October.

Agrotis gladiaria occurred from October 1 through November 7, with peak occurrence during the first three weeks in October.

Peridroma margaritosa specimens were taken up to November 18, with three the maximum catch on any single night.

The species *Nephelodes emmedonia* was not taken from the light trap after October 17, 1957.

Adults of *Amathes bollii, Choephora fungorum,* and *Agrostis venerabilis* were at their peak of abundance during the first three weeks of October.

Agrotis ypsilon, Pseudaletia unipuncta, Feltia subterranea, Sunira bicolorago, and *Metaxaglaea viatica* were the only species taken after November 18, 1957.

Bait Line Collections

A total of 547 moths, with 13 species represented, were taken from bait collections on five nights between October 1, 1957, and December 6, 1957. A light trap was operated simultaneously with the bait line to provide a comparison as to the effectiveness of these two methods of collection. Results of this comparison are shown in Table II.

TABLE II. A comparison of bait line and light trap collections of Noctuidae (five nights between October 30 and December 6, 1957), Fayetteville, Arkansas.

Species	Bait line		Light trap	
	Rank	Per cent of total	Rank	Per cent of total
Pseudaletia unipuncta	1	61.97	1	62.64
Agrotis ypsilon	2	12.25	2	14.29
Sunira bicolorago	3	11.70	5	4.39
Metaxaglaea viatica	4	4.38	10	1.10
Feltia subterranea	5	3.11	6	2.19
Lithophane sp.	6	2.01	....	.....
Unidentified sp.	7	1.83	....	.....
Peridroma margaritosa	8	1.65	....	.....
Anicla infecta	9	.54	4	4.39
Leucania sp.	10	.18	11	1.10
Feltia ducens	11	.18	8	1.10
Lacinipolia renigera	12	.18	9	1.10
Platysenta sutor	....	.....	3	4.39
Laphygma frugiperda and *Prodenia ornithogalli*	....	.....	7	2.19
Agrotis gladiaria	....	.....	12	1.10

The data shown in Table II indicate that the species *Pseudaletia unipuncta, Agrotis ypsilon* and *Feltia subterranea* were about equally attracted to the light and to the bait.

The species *Sunira bicolorago, Metaxaglea viatica, Peridroma margaritosa, Lithophane* sp., and the unidentified species were more attracted to the bait than to the light. The species *Anicla infecta, Leucania* sp., *Feltia ducens, Lacinipolia renigera, Platysenta sutor, Laphygma frugiperda* and *Prodenia ornithogalli,* and *Agrotis gladiaria* were more attracted to the light than to the bait.

Simultaneous operation of a light trap and a bait line showed 6 times as many moths taken from the bait as from the light trap. However, since the bait collections were taken from ten sites compared to a single light trap, a single bait appeared to be less effective in attracting moths than a single light trap.

A comparison of the number of moths collected between 5:00 p.m. and 8:00 p.m. with number of moths collected between 8:00 p.m. and 10:00 p.m. revealed twice as many moths taken during the earlier interval.

SUMMARY

Because of the importance of "cutworms" as a group in northwest Arkansas, it is important to know the specific identity and relative abundance of those species involved. This was accomplished by the collection of noctuid moths from a light trap and a bait line.

Nineteen species of noctuids were recorded from light trap collections at Fayetteville, Arkansas, between October 1, 1957, and December 6, 1957.

The species, *Psuedaletia unipuncta, Feltia ducens, Lacinipolia renigera, Agrotis gladiaria* and *Agrotis ypsilon,* made up approximately 90 per cent of the total catch of noctuids.

Simultaneous operation of bait line and the light trap revealed that the species, *Psuedaletia unipuncta, Agrotis ypsilon,* and *Feltia subterranea* were equally attracted to the bait and the light trap.

Comparisons of total catch from bait and light trap showed that the light trap was more effective than a single bait. Collections of moths between 5:00 and 8:00 p.m. were compared with those made between 8:00 and 10:00 p.m. Moth activity was found to be greater during the earlier period.

LITERATURE CITED

Cook, William C. 1928. Light traps as indicators of cutworm moth populations. Can. Ent. 60(5):103-109.

NOTICE OF ANNUAL MEETING

The annual meeting of the Kansas Entomological Society (Central States Entomological Society) will be held in the Union building of the University of Kansas, Lawrence, on 2 May 1959. Detailed announcements will be sent to entomological departments and organizations, but this will be the only announcement made to individual members.

A DISPERSAL MECHANISM IN MITES (Acarina: Anoetidae)[1]

C. C. HALL, JR.[2]

It is more or less common knowledge that mites in various stages of development attach to insects and in that way may be carried great distances. The flight of the insect plus the influence of wind could easily carry attached mites several miles.

Hypopi of mites are frequently found attached to insects, but there is relatively little information as to how the hypopi achieve this attachment. While working with *Drosophila* in the genetics laboratory it was noted that hypopi of mites contaminating the culture assembled in great numbers on the bottle cap and seemed to be jumping when the bottle was touched or moved. If this has been reported previously, it seems to have been obscurely placed in the literature. The "genetics laboratory" mite, *Histiostoma laboratorium* Hughes, is one species in which hypopial stages are capable of jumping and clinging to objects which pass over them.

To prove the suspected jumping of hypopi the following simple experiment was performed: *Drosophila* culture bottles, contaminated with mites, were allowed to stand for several days until hypopi were very abundant on the paper bottle caps. A pencil (metal, wood, or plastic) was passed slowly over the cap about one fourth of an inch from the cap but not touching it. Dozens of hypopi were then seen on the pencil. Static electricity was considered as a possible explanation for this mite movement, but hypopi can be observed jumping without passing anything over them. In addition the hypopi always land in a walking position and are not stuck to the pencil in positions that would seem likely if static electricity were responsible for this movement. By examining hypopi under a dissecting microscope they may be seen jumping as the jar is slowly rotated; the movement of the jar is enough to stimulate some mites to jump. The height or distance of the jump is often one to two inches. Jumping appears to be indiscriminate at times, yet it is possible to single out an indvidual mite and induce it to leap onto a small needle. It seems obvious that if hypopi can jump and cling to a polished metal needle, they could easily jump toward and cling to an insect.

To test this hypothesis, a living fly, without attached hypopi, was glued by the dorsum to a dissecting needle (minuten Nadel) and slowly passed about one fourth of an inch above a bottle cap heavily infested with hypopi. The fly was not allowed to touch the cap at any time and was held above the bottle cap for about five seconds. This was done under a dissecting microscope, and hypopi could be seen jumping. When the fly was examined, eight hypopi were observed crawling about on the thorax and abdomen. As many as fifty hypopi have been observed on a single fly taken from a cul-

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[1] Contribution No. 992, Department of Entomology, University of Kansas.
[2] Department of Biology, Howard College, Birmingham, Alabama.

ture bottle infested with mites. Although it was not observed, I believe that these hypopi are successful in attaching themselves to insects in flight.

The manner of jumping appears to be as follows: hypopi rest in a tilted position with the posterior end close to the surface and the anterior part of the body slightly elevated. Legs I and II are extended forward and are visible in dorsal view. Legs IV are extended posteriorly and are partly visible in dorsal view. Legs III are extended anteriorly in a V-shaped position and drawn inward toward the median line of the body so that only their tips can be seen when viewed from above. Legs III have coxal articulation which differs from that of the other legs and allows much more freedom of movement. In this tilted position, with legs III directed anteriorly and drawn inward, a quick downward push of legs III would throw the hypopus into the air. Only the mites in this pre-jumping position were observed to jump onto the small dissecting needle when it was passed over them. Legs IV seem to have no function in jumping or walking and are dragged along behind while the mite is walking.

Schulze (1924) states that hypopi of *Tyroglyphus farinae* (L.) assume a position similar to the tilted position described above, but he does not mention jumping. His observations were that hypopi would, when touched, attach themselves to the host. The hypopi in this case held the front legs up in the air.

The exact stimulus which causes jumping is not clear. It seems likely that vibrations or air currents may be the stimuli involved, but convincing evidence to support this is not available at this time.

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Hughes, R. D. 1950. The genetics laboratory mite, *Histiostoma laboratorium*, n. sp. (Anoetidae). Journal of the Washington Academy of Sciences, 40(6):177-183.

Schulze, H. 1924. Zur Kenntnis der Dauerformen (Hypopi) der Mehlmilbe, *Tyroglyphus farinae* L. Centralblatt für Bacteriologie, Parasitenkunde und Infectionkrankheiten, II, 9(22-24):536-549.

AN UNUSUAL NEST OF THE HONEY BEE[1]

GEORGE W. BYERS

Although honey bees (*Apis mellifera* Linnaeus) ordinarily construct their nests within some sort of enclosure, such as a hollow tree, cave or man-made hive, exposed nests are occasionally discovered. *Apis florea* and *Apis dorsata*, near relatives of this European species of honey bee, found in India and other parts of southern Asia, normally build exposed nests consisting of a single comb. As the genus *Apis* is thought to have originated in southern Asia, it seems not unlikely that the instinct to make concealed nests has developed in those species now found in temperate regions as a selective adaptation to the cooler environment, particularly to the cold winters. In the warmer regions where *Apis mellifera* occurs, unprotected nests are not

[1] Contribution No. 1038 from the Department of Entomology, University of Kansas, Lawrence, Kansas.

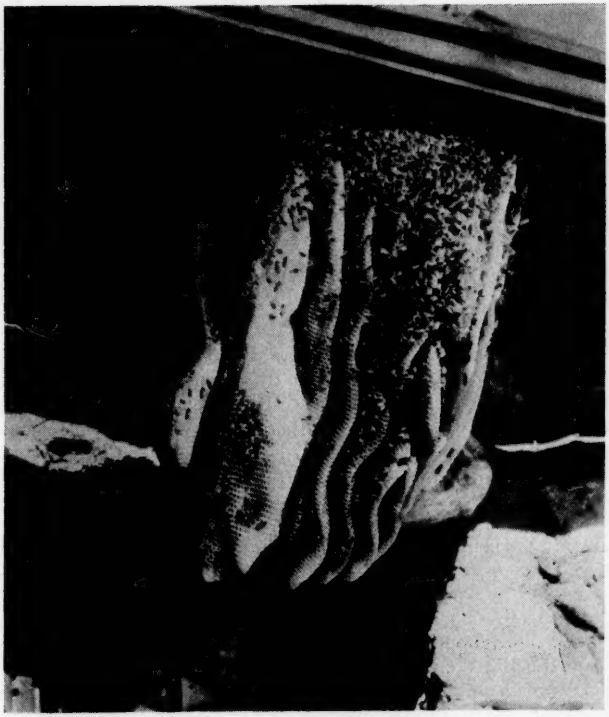

Fig. 1. An exposed nest of the honey bee that remained occupied through three successive winters.

rare, but at latitudes where winters are very cold, bees in nests that are not protected are not likely to survive from one summer to the next. Even when the nest is sheltered, the bees often die from severe cold or from starvation if their supply of honey becomes exhausted. It is therefore of some interest when a colony of bees in an exposed nest is observed to survive one or more cold winters.

In early autumn of 1956, my attention was called to a large, exposed nest of honey bees, hanging beneath the eaves of a cottage at Lone Star Lake, about ten miles southwest of Lawrence, Douglas County, Kansas. According to the owners of the house, Mr. and Mrs. Carl Clifton, the nest had first been noticed in the summer of 1954, had reached considerable size that season, and had successfully withstood the winters of 1954-55 and 1955-56. By September 1956, the nest comprised eleven large combs and several smaller ones, most of which are visible in figure 1. The larger combs were 30 inches or more in length and stood out about 18 inches from the

stone wall to which they were attached at one side. The nest was suspended from a 20-inch length of the roof. Father J. S. Moure, visiting Brazilian authority on bees, estimated the population of the nest to be approximately 15,000 individuals. Beneath the same eaves were dozens of nests of the mud-dauber wasp, *Sceliphron cementarium,* and several small, occupied nests of *Polistes* wasps, some of each and one of an unidentified genus being attached within 18 inches of the bees' nest.

Three instances of robbing of the hive by "black" honey bees were noted during an hour's observation in September. Such an exposed nest is apparently not easily defensible, and in each case the larger, robbing bee readily made its way into the recesses of the hive but was ejected only minutes later, issuing through a localized turmoil of worker bees and dropping toward the ground with a single worker somehow attached to it. All the robber bees managed to escape by throwing off the smaller defender. It was noticed, on a later trip, that a few of the dark honey bees were going in and out of a hole between the roof and the stone wall of the same cottage but on the shaded side. It seemed that such an entrance might have been the origin of the large hive, but Mr. Clifton did not believe that the bees had been entering the house at all.

On 23 December 1956, when the temperature was only slightly below freezing, the bees were found crowded together far up among the combs, as is their custom even in enclosed nests, in order to effect maximum conservation of metabolic heat. Of course, there seemed to be fewer of them than when they were photographed in the fall, but no bees were lying dead in the snow beneath the nest, such as one may find near a bee tree in winter. Between this visit and the next, on 5 February 1957, the temperature had several times dropped to near 0° F. and below; and approximately the lower one-third of the combs had been broken off, apparently by children using a long stick found nearby. However, the bees were still present in fairly large numbers, mostly clustered tightly together among the combs, as before. Although the temperature was only 38° F. during the February observation, one bee was seen flying near the nest, and a few others were crawling over the combs. (Brood production is sometimes begun by bees in protected nests as early as this date.) Since the bees had endured the coldest part of winter, it seemed likely that they could survive to the next spring in spite of the damage done to their nest. Probably the location of the nest made it possible for the bees to overwinter in it, even though it was unenclosed. The stone wall against which it hung faced only slightly west of south, so that the nest received full benefit of the sun through the leafless trees, which in the summer afforded the nest some shade. A steep slope to the north and west behind the house protected the site from the strongest and coldest winter winds, and the roof of the building prevented damage to the nest by rain.

Although the nest was almost completely destroyed in the following year, some new comb was constructed in the summer of 1958. This new construction was small and not occupied as of 23 December 1958, but considerable numbers of bees were flying in and out of a crack between the masonry and the wooden roof, only four feet away from the old nest site.

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